Data Validation (DV) Report

for TESS ID 410153553
Sectors 1 - 28
Cadence: TARGET (2-min)

This Data Validation Report was produced in the
TESS Science Processing Operations Center (SPOC) Pipeline
at NASA Ames Research Center

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1 Summary

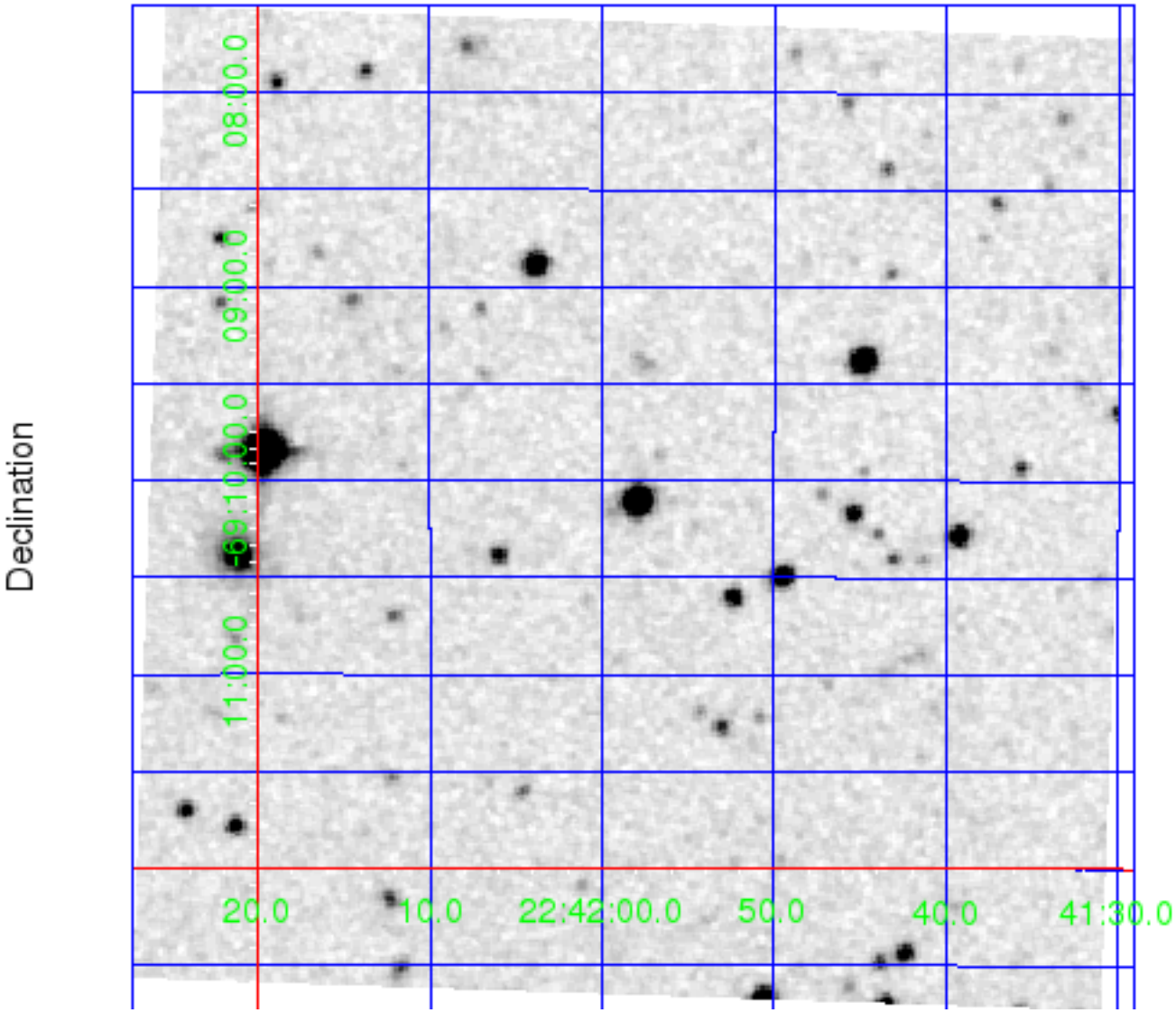
Target Properties	Value	Uncertainty	Units	Provenance
Catalog ID	410153553			
TOI ID	136			
TESS Name	-			
RA	340.49215557	0	degrees	TIC8.1
Dec	-69.16897804	0	degrees	TIC8.1
Magnitude	11.9238	0.0076985		TIC8.1
Radius	0.189	0.006	Solar radii	TIC8.1
Effective Temperature	3004	157	Kelvin	TIC8.1
log(g)	5.085	0.029186	cm/sec^2	TIC8.1
[M/H]	0.000	0	Solar metallicity	Solar
Stellar Density	23.533	1.735	Solar density	TIC8.1-Derived
Limb Darkening Coefficient 1	0.6548			
Limb Darkening Coefficient 2	0.3397			
Limb Darkening Coefficient 3	-0.3119			
Limb Darkening Coefficient 4	0.0792			
Number of Planet Candidates	1			
TOI Model	csv-file-toi-catalog-05-01-21-edited.csv			
TESS Names Model	-			
External TCE Model	-			
Software Revision	spoc-5.0.30-20210519			
Date Report Generated	27-May-2021 05:11:34 Z			

Sector	Target Table	Camera/ CCD	Crowding Metric	Flux Fraction
1	128	3:2	0.9779	0.8145
27	258	3:1	0.9820	0.8075
28	264	3:2	0.9927	0.8150

Planet Candidate	TOI ID	TESS Name	TOI Correlation	Period (days)	Period Ratio	Epoch (BTJD)	Semi-major Axis (AU)	Radius (Re)	Seff	Teq (K)	False Alarm	Suspected EB
1	-	-	-	0.463	1.00	1325.725	0.01	1.5	64.7	723	2.91e-314	false

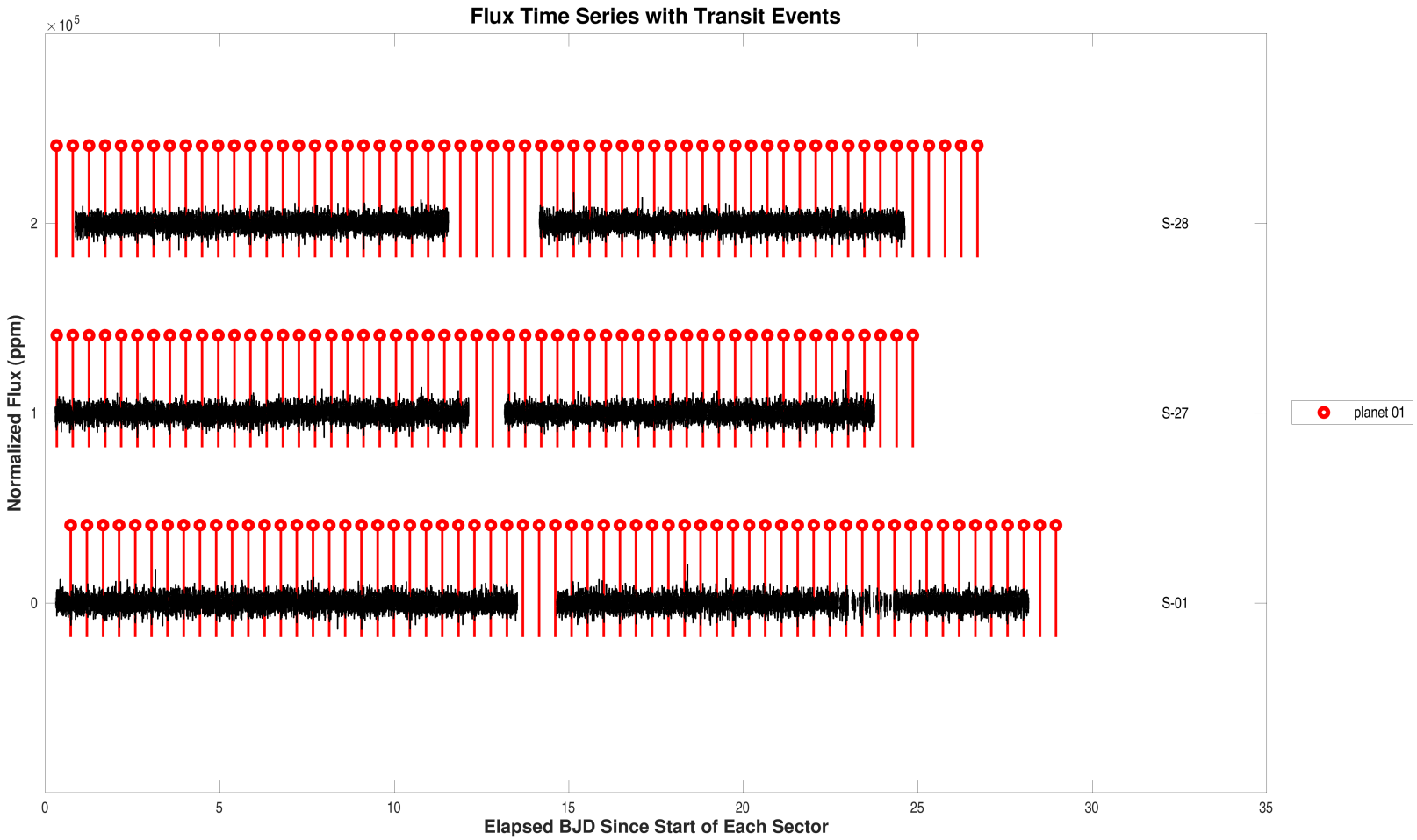
DV did not produce matching results for the following TOI IDs: 136.01

2 Survey Image

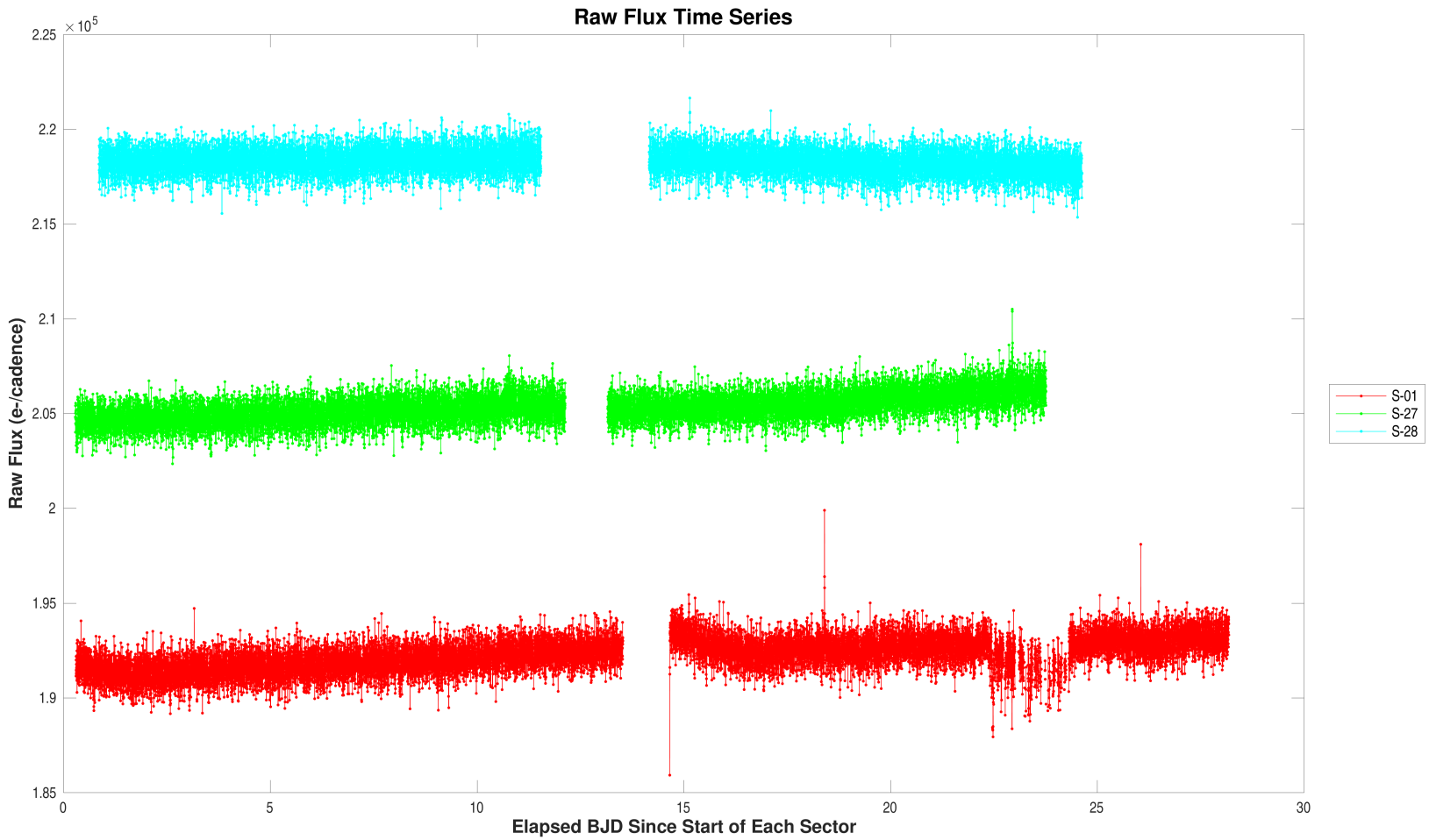


Digitized Sky Survey (DSS) red image. The 5' x 5' image is centered on the J2000 coordinates of target (410153553).

3 Flux Time Series



Summary plot of sector-stitched flux time series and transits for target 410153553, marked with DV fitted epoch/period (or TPS epoch/period if fit was not successful). Transits of identified planets are labeled with epoch BTJD and orbital period. For the data of sector 1, target table 128, start BJD is 2458325 and the vertical offset is 0 ppm. For the data of sector 27, target table 258, start BJD is 2459036 and the vertical offset is 100000 ppm. For the data of sector 28, target table 264, start BJD is 2459061 and the vertical offset is 200000 ppm.
Open `./summary-plots/0000000410153553-00-flux-dv-fit-01-128.fig`



Summary plot of raw flux time series. For the data of sector 1, target table 128, start BJD is 2458325 and the vertical offset is 0 electrons/cadence. For the data of sector 27, target table 258, start BJD is 2459036 and the vertical offset is 13000 electrons/cadence. For the data of sector 28, target table 264, start BJD is 2459061 and the vertical offset is 26000 electrons/cadence.
Open `./summary-plots/0000000410153553-00-raw-flux-01-128.fig`

4 Dashboards

Planet Candidate 1

<table>
<tr><td rowspan="2">Model Fitter</td><td colspan="2">Stellar Radius
0.2 ± 0.0 Solar units</td><td rowspan="2">Core Aperture Correlation Statistic
Value = 32.96
Significance = 100.00%
Halo Aperture Correlation Statistic
Value = 7.95
Significance = 100.00%
Core/Halo Ratio
Ratio = 4.15</td><td rowspan="2">Ghost Diagnostic Test</td></tr>
<tr><td colspan="2">Period = 0.5 ± 0.0 days
Depth = 4678 ± 172 ppm
Planet Radius = 1.5 ± 0.1 Earth radii
Semi-major Axis = 0.0 ± 0.0 AU
Effective Stellar Flux = 64.7 ± 13.9
Equilibrium Temperature = 723 ± 39 Kelvin
Chi-squared/DoF = 0.8
SNR = 53.1</td></tr>
<tr><td rowspan="2">Eclipsing Binary Discrimination Test</td><td colspan="2">Odd-Even Depth Comparison Statistic
Value = 6.11e-03
Significance = 93.77%</td><td>Offsets Relative to Out of Transit Centroid
Source RA Offset = 1.18e+00 ± 2.67e+00 arcsec (0.44 σ)
Source Dec Offset = 1.31e-01 ± 2.52e+00 arcsec (0.05 σ)
Source Offset Distance = 1.19e+00 ± 2.67e+00 arcsec (0.45 σ)
Offsets Relative to TIC Position
Source RA Offset = -2.34e+00 ± 2.74e+00 arcsec (-0.85 σ)
Source Dec Offset = 3.19e+00 ± 2.64e+00 arcsec (1.21 σ)
Source Offset Distance = 3.96e+00 ± 2.68e+00 arcsec (1.48 σ)</td><td>Difference Image Centroid Offsets</td></tr>
<tr><td>Shorter Period Comparison Statistic
Value = N/A
Significance = N/A</td><td>Longer Period Comparison Statistic
Value = N/A
Significance = N/A</td><td>False Alarm = 2.91e-314
Transit Count = 1645
Max Multiple Event Statistic = 38.9</td><td>Bootstrap Test</td></tr>
</table>

Summary of model fitter results and validation test results for target 410153553, planet candidate 1. In general, green denotes that the candidate is likely a planet, while red denotes that the candidate is unlikely to be a planet. Cyan denotes that no data is available. The color of the Model Fitter block is: green, when the SNR of the fit is greater than or equal to 10; yellow, if the SNR is greater than or equal to 7.1 but less than 10; red, if the SNR is less than 7.1 or if the fitter failed. The color of the Ghost Diagnostic Test and Eclipsing Binary Discrimination Test blocks are: green, when the significance is within 2-sigma; yellow, when the significance is between 2- and 3-sigma; red when the significance is greater than 3-sigma. The color of the Difference Image Centroid Offsets block is: green, when the max offset distance sigma is less than or equal to 2; yellow, when the max sigma is between 2 and 3; red when the max sigma is greater than 3. The color of the Bootstrap Test block is green whenever the false alarm probability is less than 10^{-12}, low enough to limit the total number of false alarms from a four year mission to less than one. If the false alarm probability is greater than 10^{-12}, the color of the Bootstrap Test block is: green, when the false alarm probability is less than or equal to the CCDF of a Gaussian distribution at the observed maximum multiple event statistic; yellow when the false alarm probability is between 1 and 2 times that of a Gaussian distribution at the max multiple event statistic; and red when the false alarm probability is more than 2 times that of a Gaussian distribution at the max multiple event statistic.

5 Pixel Level Diagnostics

To reduce clutter, the catalog IDs in the difference images have been replaced by indices representing distance from the target star. The mapping between the indices and the catalog IDs is found in a table at the end of this section.

5.1 Planet Candidate 1

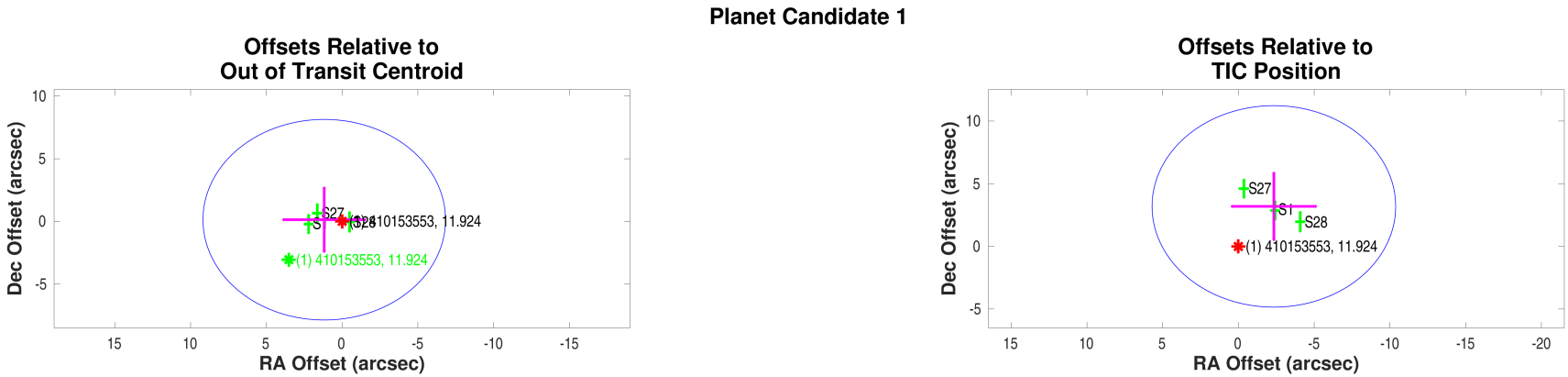
Multi-Sector Average PRF Fit of the Difference Images

Mean offset from the PRF fit to the out of transit image

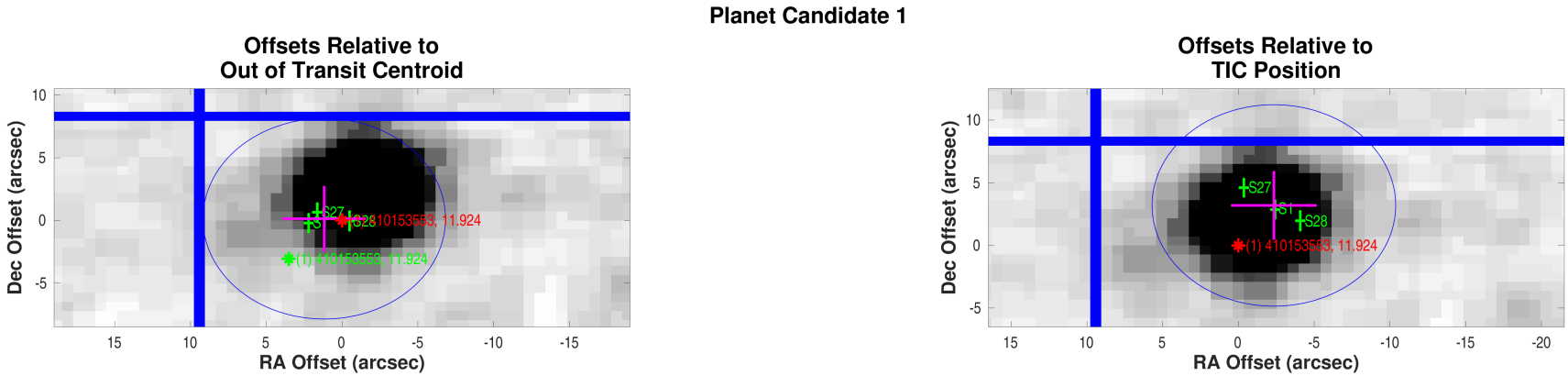
	RA	Dec	Units
Offset	$1.1816 \pm 2.67e+00$	$0.1314 \pm 2.52e+00$	arcseconds
Offset/σ	0.44	0.05	
Offset Distance	$1.1889 \pm 2.67e+00$		arcseconds
Offset Distance/σ	0.45		
3σ Radius	8.0016		arcseconds

Mean offset from the TIC RA and Dec

	RA	Dec	Units
Offset	$-2.3426 \pm 2.74e+00$	$3.1942 \pm 2.64e+00$	arcseconds
Offset/σ	-0.85	1.21	
Offset Distance	$3.9612 \pm 2.68e+00$		arcseconds
Offset Distance/σ	1.48		
3σ Radius	8.0380		arcseconds



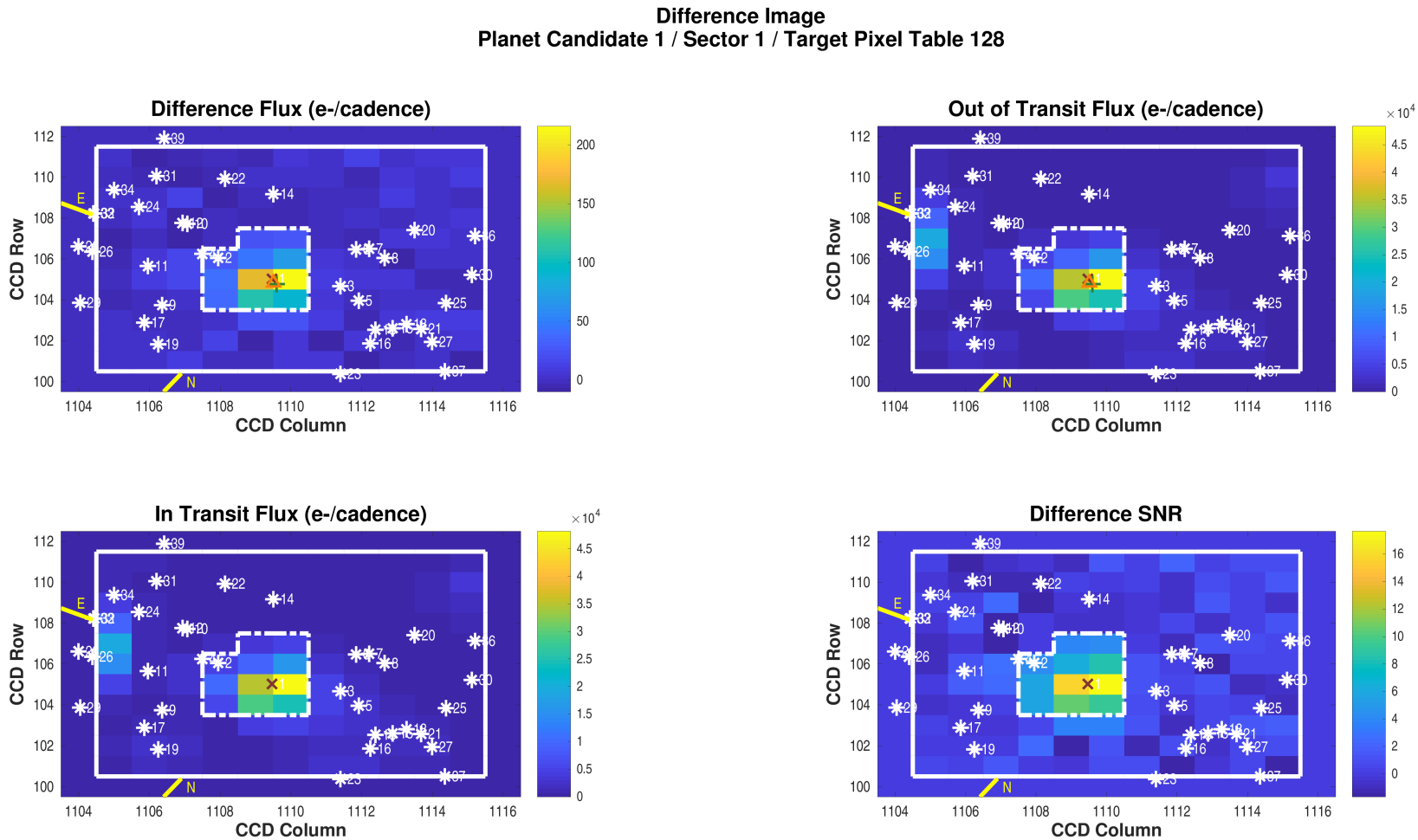
Difference image centroid offsets for target 410153553, planet candidate 1. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TC coordinates of the given target. Symbol key: green cross: per sector centroid offsets with 1-sigma error bars in RA and Dec; magenta cross: robust weighted mean offset over all sectors with 1-sigma error bars in RA and Dec; blue circle: 3-sigma radius of confusion for weighted mean offset; red asterisk: location of target star (out-of-transit centroid in left panel and TIC position in right panel); green asterisk: TIC location of target star with respect to out-of-transit centroid; blue asterisk: location of other TIC objects in the neighborhood. TIC ID and magnitude are noted in the text associated with each marked object. A constant error term of 2.5000 arcseconds has been added in quadrature to the computed uncertainty in the RA and Dec components of the robust mean offset.
Open `./planet-01/difference-image/0000000410153553-01-difference-image-centroid-offsets.fig`



Difference image centroid offsets for target 410153553, planet candidate 1, diplayed on survey image for given target. Left: difference image PRF centroid offsets in RA and Dec with respect to the per sector out-of-transit centroids for the given target. Right: difference image PRF centroid offsets in RA and Dec with respect to the TIC coordinates of the given target. Symbol key: green cross: per sector centroid offsets with 1-sigma error bars in RA and Dec; magenta cross: robust weighted mean offset over all sectors with 1-sigma error bars in RA and Dec; blue circle: 3-sigma radius of confusion for weighted mean offset; red asterisk: location of target star (out-of-transit centroid in left panel and TIC position in right panel); green asterisk: TIC location of target star with respect to out-of-transit centroid; blue asterisk: location of other TIC objects in the neighborhood. TIC ID and magnitude are noted in the text associated with each marked object. A constant error term of 2.5000 arcseconds has been added in quadrature to the computed uncertainty in the RA and Dec components of the robust mean offset.
Open `./planet-01/difference-image/0000000410153553-01-difference-image-centroid-offsets-survey.fig`

Difference Image Summary Metrics

Number of Difference Images	Number of Metrics	Number of Good Metrics	Fraction of Good Metrics	Quality Threshold
3	3	3	1.0000	0.70



Difference image for target 410153553, planet candidate 1, sector 1, target pixel table 128. Upper left: difference between mean flux out-of-transit and in-transit; upper right: mean out-of-transit flux; lower left: mean in-transit flux; lower right: difference between mean flux out-of-transit and in-transit after normalizing by the uncertainty in the difference for each pixel. The optimal aperture is outlined with a white dash-dotted line in each panel and the target mask is outlined with a solid white line. Symbol key: x: target position from TIC RA and Dec converted to CCD coordinates via motion polynomials; *: position of nearby TIC objects converted to CCD coordinates via motion polynomials; +: PRF-fit location of target from out-of-transit image; triangle: PRF-fit location of transit source from the difference image. Number of transits = 53; number of valid in-transit cadences = 529; number of in-transit cadence gaps = 8; number of valid out-of-transit cadences = 2402; number of out-of-transit cadence gaps = 31. Difference image quality metric = 0.98 (good).
Open `./planet-01/difference-image/0000000410153553-01-difference-image-01-128.fig`

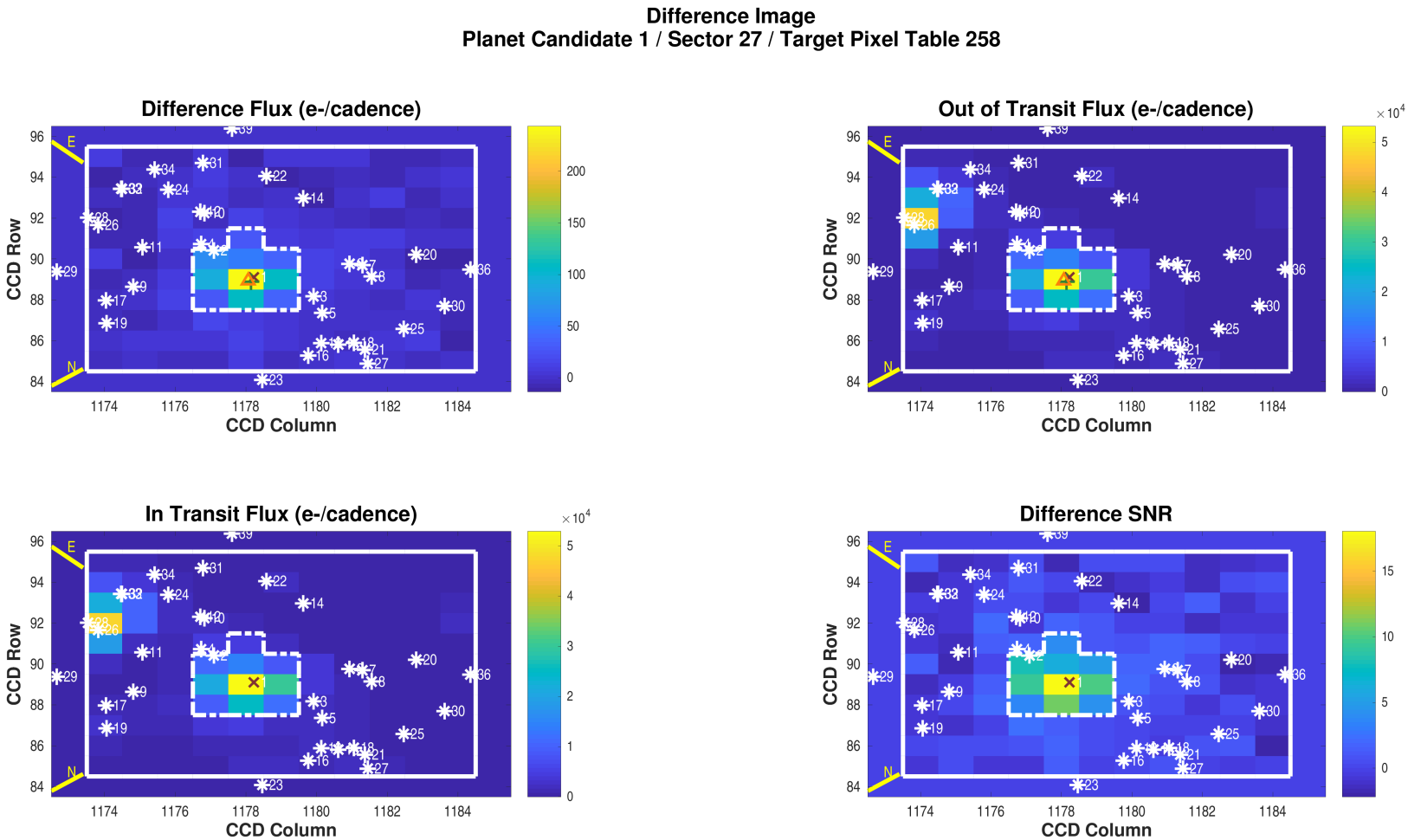
PRF Fit of the Difference Image

Offset from the PRF fit to the out of transit image

	Row	Column	Units	RA	Dec	Units
Out of Transit Image Centroid	$104.77 \pm 6.43e-05$	$1109.60 \pm 5.82e-05$	pixels	$340.49339541 \pm 1.21e-06$	$-69.17187924 \pm 1.28e-06$	degrees
Difference Image Centroid	$104.84 \pm 3.61e-02$	$1109.51 \pm 3.06e-02$	pixels	$340.49512263 \pm 1.88e-04$	$-69.17193884 \pm 1.94e-04$	degrees
Offset	$0.0691 \pm 3.61e-02$	$-0.0911 \pm 3.06e-02$	pixels	$2.2109 \pm 2.43e-01$	$-0.2146 \pm 6.97e-01$	arcseconds
Offset/σ	1.91	-2.98		9.11	-0.31	
Offset Distance	$0.1144 \pm 3.32e-02$		pixels	$2.2213 \pm 2.61e-01$		arcseconds
Offset Distance/σ	3.45			8.51		

Offset from the TIC RA and Dec converted to pixels via motion polynomials

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$105.03 \pm 2.18e-04$	$1109.47 \pm 2.00e-04$	pixels	$340.49701383 \pm 0.00e+00$	$-69.17273439 \pm 0.00e+00$	degrees
Difference Image Centroid	$104.84 \pm 3.61e-02$	$1109.51 \pm 3.06e-02$	pixels	$340.49512263 \pm 1.88e-04$	$-69.17193884 \pm 1.94e-04$	degrees
Offset	$-0.1903 \pm 3.61e-02$	$0.0362 \pm 3.06e-02$	pixels	$-2.4207 \pm 2.41e-01$	$2.8640 \pm 6.97e-01$	arcseconds
Offset/σ	-5.27	1.18		-10.04	4.11	
Offset Distance	$0.1937 \pm 3.61e-02$		pixels	$3.7500 \pm 5.79e-01$		arcseconds
Offset Distance/σ	5.37			6.48		



Difference image for target 410153553, planet candidate 1, sector 27, target pixel table 258. Upper left: difference between mean flux out-of-transit and in-transit; upper right: mean out-of-transit flux; lower left: mean in-transit flux; lower right: difference between mean flux out-of-transit and in-transit after normalizing by the uncertainty in the difference for each pixel. The optimal aperture is outlined with a white dash-dotted line in each panel and the target mask is outlined with a solid white line. Symbol key: x: target position from TIC RA and Dec converted to CCD coordinates via motion polynomials; *: position of nearby TIC objects converted to CCD coordinates via motion polynomials; +: PRF-fit location of target from out-of-transit image; triangle: PRF-fit location of transit source from the difference image. Number of transits = 47; number of valid in-transit cadences = 473; number of in-transit cadence gaps = 0; number of valid out-of-transit cadences = 2157; number of out-of-transit cadence gaps = 0. Difference image quality metric = 0.97 (good).
Open `./planet-01/difference-image/0000000410153553-01-difference-image-27-258.fig`

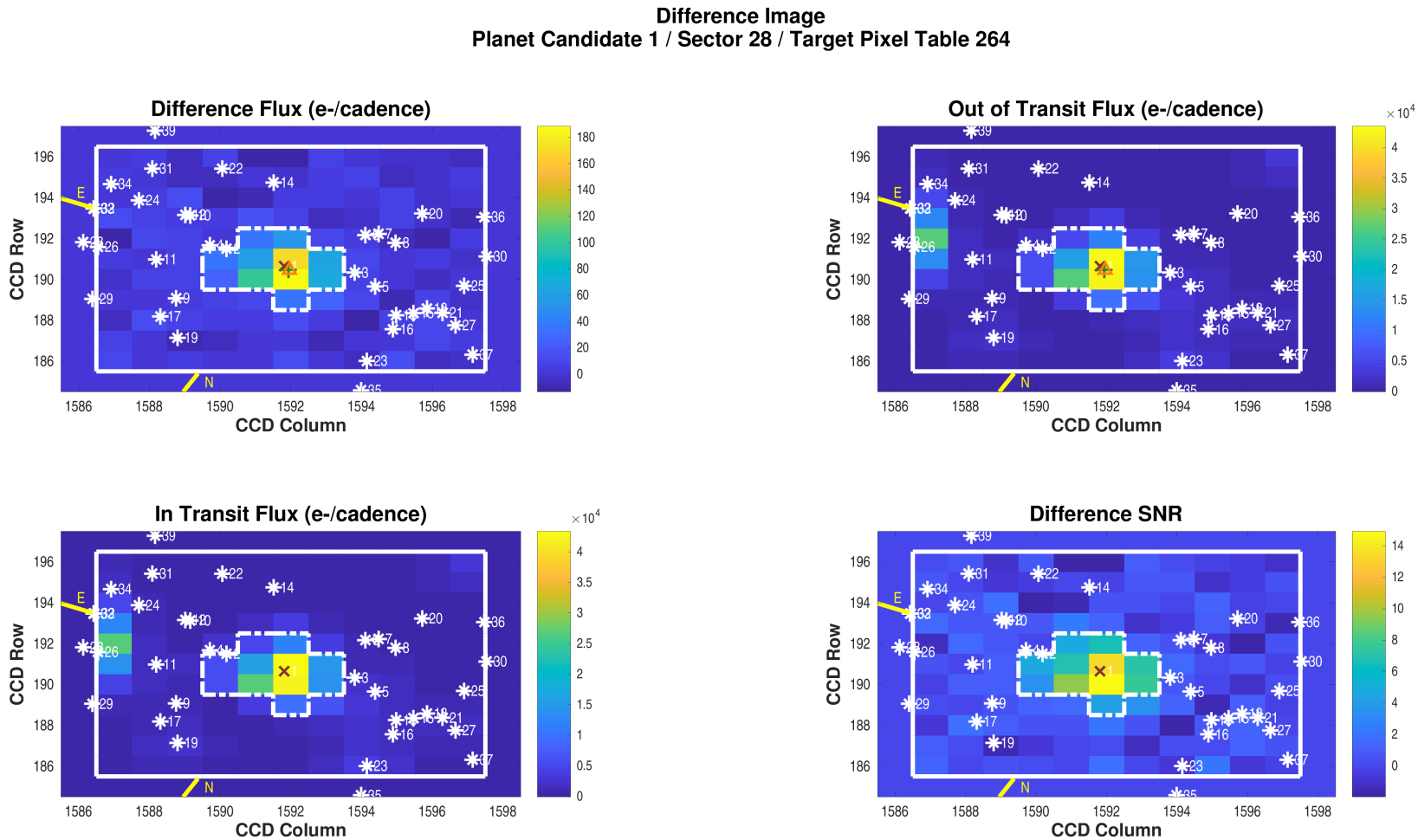
PRF Fit of the Difference Image

Offset from the PRF fit to the out of transit image

	Row	Column	Units	RA	Dec	Units
Out of Transit Image Centroid	$88.89 \pm 6.57e-05$	$1178.14 \pm 6.26e-05$	pixels	$340.49595780 \pm 1.26e-06$	$-69.17202722 \pm 1.21e-06$	degrees
Difference Image Centroid	$88.93 \pm 3.57e-02$	$1178.06 \pm 3.36e-02$	pixels	$340.49723753 \pm 2.07e-04$	$-69.17184632 \pm 1.90e-04$	degrees
Offset	$0.0386 \pm 3.57e-02$	$-0.0773 \pm 3.36e-02$	pixels	$1.6381 \pm 2.65e-01$	$0.6513 \pm 6.83e-01$	arcseconds
Offset/σ	1.08	-2.30		6.17	0.95	
Offset Distance	$0.0864 \pm 3.46e-02$		pixels	$1.7628 \pm 3.50e-01$		arcseconds
Offset Distance/σ	2.50			5.04		

Offset from the TIC RA and Dec converted to pixels via motion polynomials

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$89.10 \pm 2.08e-04$	$1178.23 \pm 2.03e-04$	pixels	$340.49752096 \pm 0.00e+00$	$-69.17312650 \pm 0.00e+00$	degrees
Difference Image Centroid	$88.93 \pm 3.57e-02$	$1178.06 \pm 3.36e-02$	pixels	$340.49723753 \pm 2.07e-04$	$-69.17184632 \pm 1.90e-04$	degrees
Offset	$-0.1747 \pm 3.57e-02$	$-0.1617 \pm 3.36e-02$	pixels	$-0.3628 \pm 2.65e-01$	$4.6087 \pm 6.83e-01$	arcseconds
Offset/σ	-4.90	-4.82		-1.37	6.75	
Offset Distance	$0.2380 \pm 3.40e-02$		pixels	$4.6229 \pm 6.81e-01$		arcseconds
Offset Distance/σ	7.01			6.79		



Difference image for target 410153553, planet candidate 1, sector 28, target pixel table 264. Upper left: difference between mean flux out-of-transit and in-transit; upper right: mean out-of-transit flux; lower left: mean in-transit flux; lower right: difference between mean flux out-of-transit and in-transit after normalizing by the uncertainty in the difference for each pixel. The optimal aperture is outlined with a white dash-dotted line in each panel and the target mask is outlined with a solid white line. Symbol key: x: target position from TIC RA and Dec converted to CCD coordinates via motion polynomials; *: position of nearby TIC objects converted to CCD coordinates via motion polynomials; +: PRF-fit location of target from out-of-transit image; triangle: PRF-fit location of transit source from the difference image. Number of transits = 45; number of valid in-transit cadences = 455; number of in-transit cadence gaps = 0; number of valid out-of-transit cadences = 2061; number of out-of-transit cadence gaps = 1. Difference image quality metric = 0.97 (good).
Open `./planet-01/difference-image/0000000410153553-01-difference-image-28-264.fig`

PRF Fit of the Difference Image

Offset from the PRF fit to the out of transit image

	Row	Column	Units	RA	Dec	Units
Out of Transit Image Centroid	$190.47 \pm 6.86e-05$	$1591.93 \pm 5.45e-05$	pixels	$340.49473008 \pm 1.12e-06$	$-69.17258093 \pm 1.13e-06$	degrees
Difference Image Centroid	$190.46 \pm 3.91e-02$	$1591.96 \pm 3.13e-02$	pixels	$340.49434956 \pm 2.00e-04$	$-69.17259422 \pm 2.05e-04$	degrees
Offset	$-0.0097 \pm 3.91e-02$	$0.0236 \pm 3.13e-02$	pixels	$-0.4871 \pm 2.56e-01$	$-0.0478 \pm 7.40e-01$	arcseconds
Offset/σ	-0.25	0.76		-1.90	-0.06	
Offset Distance	$0.0255 \pm 3.30e-02$		pixels	$0.4894 \pm 2.49e-01$		arcseconds
Offset Distance/σ	0.78			1.97		

Offset from the TIC RA and Dec converted to pixels via motion polynomials

	Row	Column	Units	RA	Dec	Units
TIC Reference Centroid	$190.65 \pm 1.75e-04$	$1591.81 \pm 1.96e-04$	pixels	$340.49753956 \pm 0.00e+00$	$-69.17314088 \pm 0.00e+00$	degrees
Difference Image Centroid	$190.46 \pm 3.91e-02$	$1591.96 \pm 3.13e-02$	pixels	$340.49434956 \pm 2.00e-04$	$-69.17259422 \pm 2.05e-04$	degrees
Offset	$-0.1891 \pm 3.91e-02$	$0.1481 \pm 3.13e-02$	pixels	$-4.0831 \pm 2.56e-01$	$1.9680 \pm 7.40e-01$	arcseconds
Offset/σ	-4.84	4.74		-15.97	2.66	
Offset Distance	$0.2402 \pm 3.68e-02$		pixels	$4.5326 \pm 4.34e-01$		arcseconds
Offset Distance/σ	6.52			10.44		

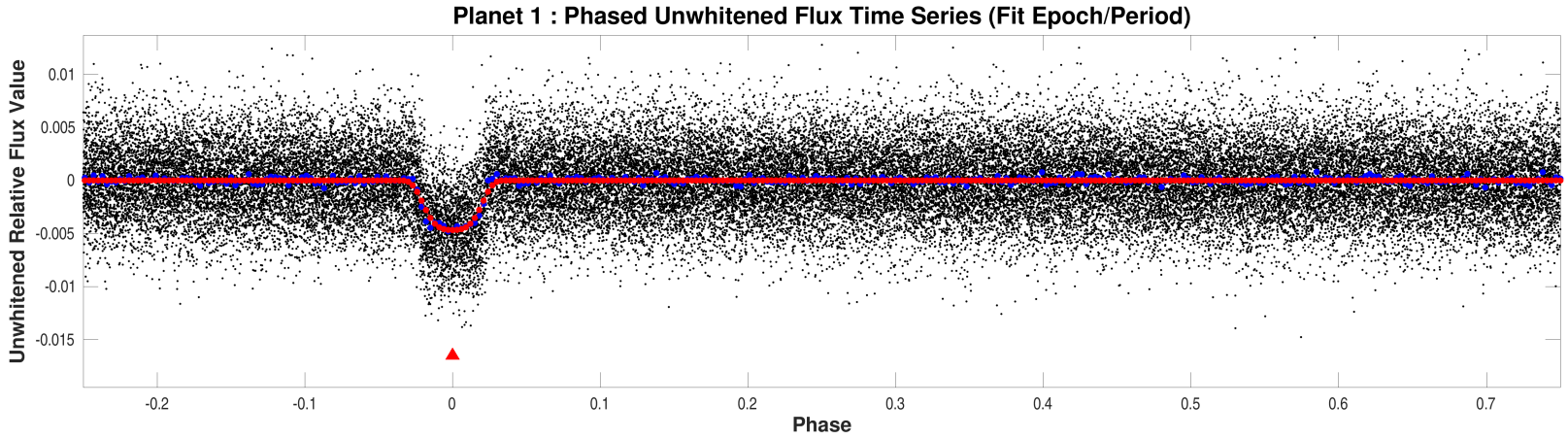
5.2 Difference Image TIC Key

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
1	410153553	11.924	340.49727622	-69.17293727	0.00
2	410153556	16.722	340.52494861	-69.17311580	35.43
3	410153559	16.669	340.46853550	-69.17671936	39.23
4	2054808756	20.140	340.53237070	-69.17272129	44.93
5	410153558	15.698	340.45644482	-69.17487321	52.73
6	410153561	18.167	340.47599680	-69.18654873	56.06
7	2054808746	19.450	340.47130818	-69.18780592	63.01
8	2054808744	19.134	340.46206936	-69.18691549	67.55
9	2054808757	19.937	340.52897260	-69.15749022	68.84
10	2054808672	18.922	340.54900619	-69.17845443	69.13
11	2054808759	20.782	340.54849469	-69.16536061	71.01
12	325177708	18.192	340.55105999	-69.17822529	71.43
13	410153554	16.478	340.43965629	-69.16952843	74.77
14	2054808743	19.720	340.52728070	-69.19249261	80.19
15	2054808752	18.759	340.43365155	-69.17126963	81.66
16	2054808753	18.898	340.43654595	-69.16588583	81.77
17	2054808758	19.606	340.52936733	-69.15196031	85.97
18	410153557	18.053	340.42992997	-69.17337787	86.22
19	410153546	15.135	340.51631720	-69.14808902	92.71
20	2054808745	20.446	340.46085205	-69.19588080	94.85
21	2054808751	18.595	340.42263318	-69.17349359	95.56
22	2054808670	18.818	340.55118477	-69.19205990	97.47
23	410153547	14.796	340.43682569	-69.15634899	97.74
24	2054808673	20.633	340.57335371	-69.17834296	99.30
25	2054808750	18.732	340.42261358	-69.18156985	100.49
26	2054808675	19.584	340.57462666	-69.16409592	104.00
27	410153555	16.103	340.41385706	-69.17139153	106.92
28	325177700	12.015	340.58178941	-69.16415836	112.70
29	325177690	17.889	340.56076300	-69.15123700	112.72
30	2054808748	19.861	340.42304389	-69.19025441	113.64
31	2054808671	20.079	340.57798963	-69.18695470	114.98
32	10002635589	15.778	340.58789100	-69.17309600	115.99
33	325177706	17.694	340.58815222	-69.17301548	116.32
34	2054808668	19.014	340.58897401	-69.18019878	120.25
35	2054808760	19.147	340.43011993	-69.14890026	121.97
36	2054808742	19.902	340.43593883	-69.19957406	123.93
37	410153551	17.717	340.39834426	-69.16561146	129.35
38	2054808765	19.650	340.46399044	-69.13782508	133.39

Index	Catalog ID	Mag	RA (degrees)	Dec (degrees)	Distance (arcsec)
39	325177717	16.866	340.58868677	-69.19627427	144.04
40	2054808762	19.607	340.42604656	-69.14185970	144.32
41	2054808761	18.776	340.43101439	-69.14002706	145.71
42	2054808763	19.810	340.40789946	-69.14592870	150.14
43	325177689	18.681	340.58438567	-69.14332142	154.27
44	2054808764	18.743	340.40470353	-69.14293899	160.32

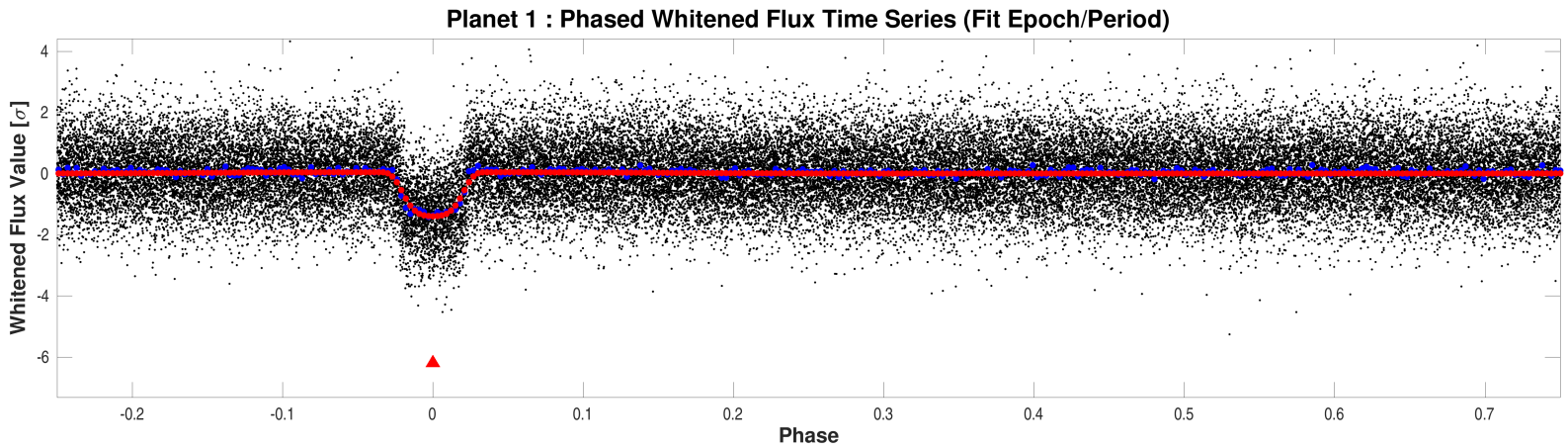
RA, Dec and Distances are corrected for proper motion. This table may not contain all of the objects shown.

6 Phased Light Curves

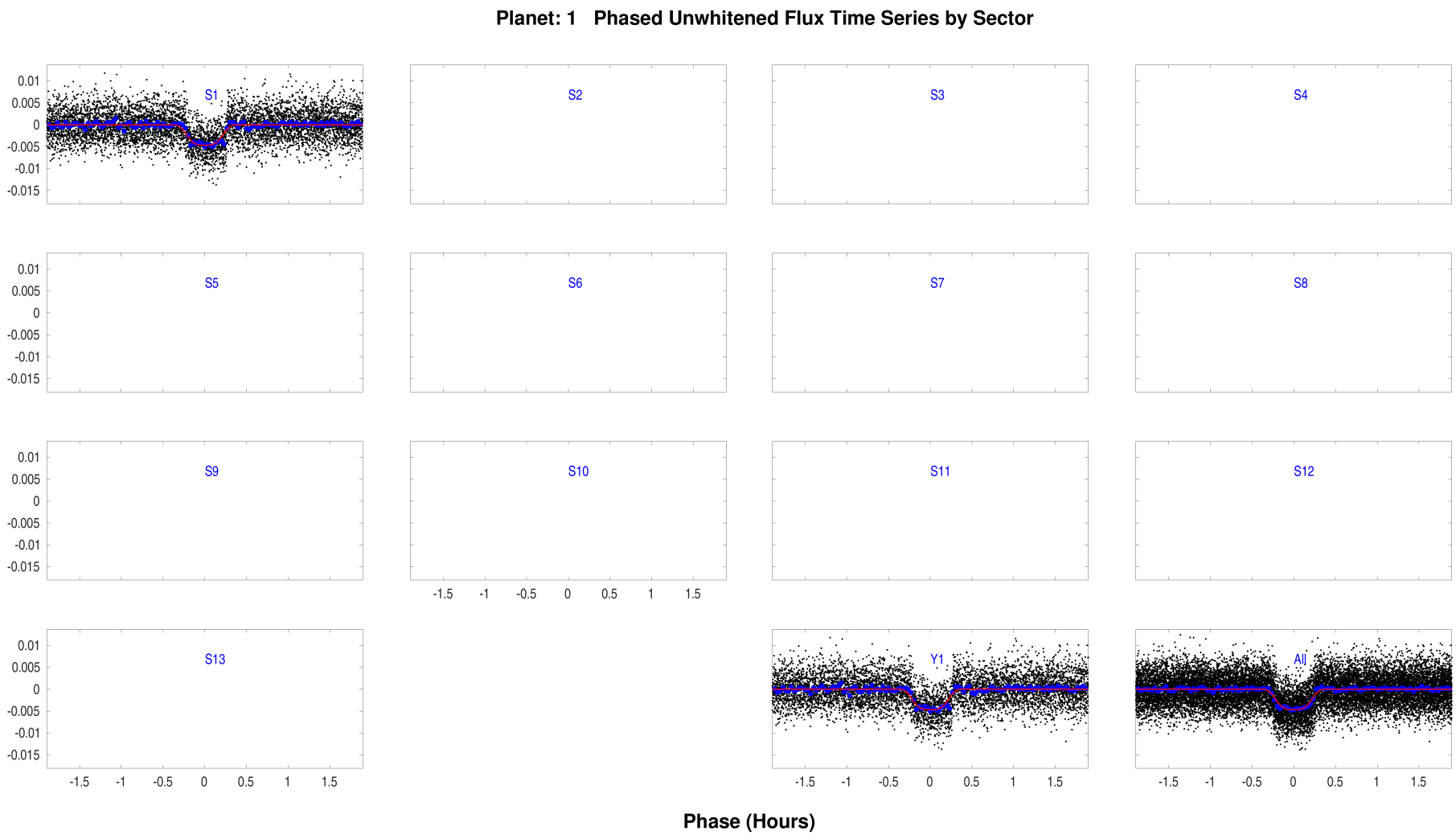


Phased unwhitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased unwhitened flux time series averaged in one cadence wide bins are plotted in bigger blue dots. When all transits fit completes with full or secondary convergence, the averaged values of the phased unwhitened fitted model light curve are plotted in red dots. Transit event markers in different colors indicate the locations of the transits of all planet candidates. The transits of the same planet candidate are labeled with the markers of the same color, for example, blue markers for transits of plane candidate #1, red markers for transits of planet candidate #2, etc.

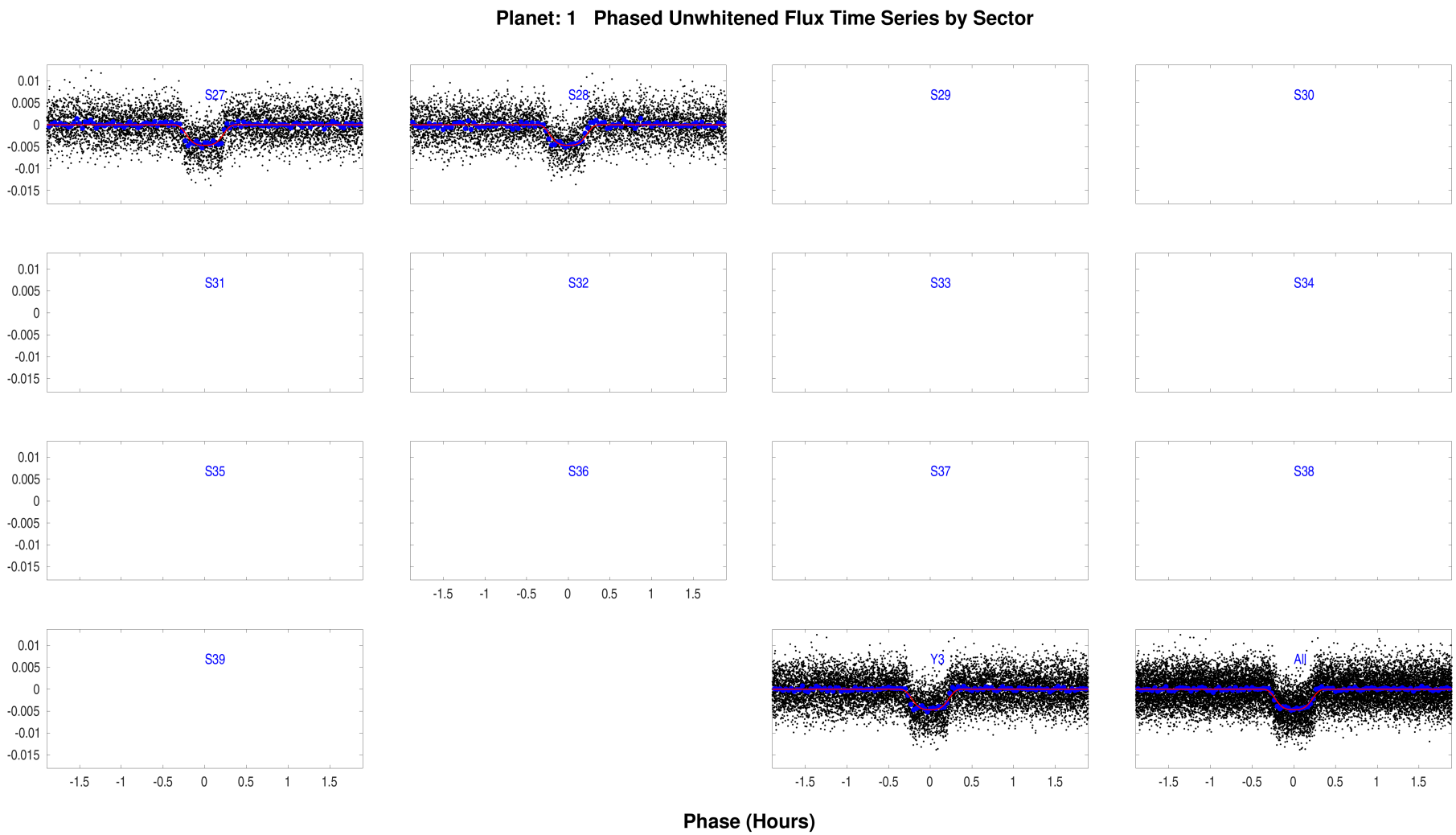
Open `./summary-plots/0000000410153553-01-phased-unwhitened-flux-time-series.fig`



Phased whitened flux time series is plotted in black dots. When all transits fit completed with full or secondary convergence, the phase is determined with the fitted epoch and period; otherwise, the phase is determined with the TPS epoch and period. The values of the phased whitened flux time series averaged in one cadence wide bins are plotted in bigger blue dots. When all transits fit completes with full or secondary convergence, the averaged values of the phased whitened fitted model light curve are plotted in red dots. Transit event markers in different colors indicate the locations of the transits of all planet candidates. The transits of the same planet candidate are labeled with the markers of the same color, for example, blue markers for transits of plane candidate #1, red markers for transits of planet candidate #2, etc.
Open `./summary-plots/0000000410153553-01-phased-whitened-flux-time-series.fig`



Phased unwhitened flux time series by sector in year 1 for target 410153553, planet candidate 1. Period = 0.46293 days; transit epoch = 1325.7247 BTJD. Open `./summary-plots/0000000410153553-01-phased-unwhitened-flux-time-series-by-sector-01.fig`



Phased unwhitened flux time series by sector in year 3 for target 410153553, planet candidate 1. Period = 0.46293 days; transit epoch = 1325.7247 BTJD. Open `./summary-plots/0000000410153553-01-phased-unwhitened-flux-time-series-by-sector-03.fig`

7 Planet Candidate 1

7.1 Model Fitter: All Transits

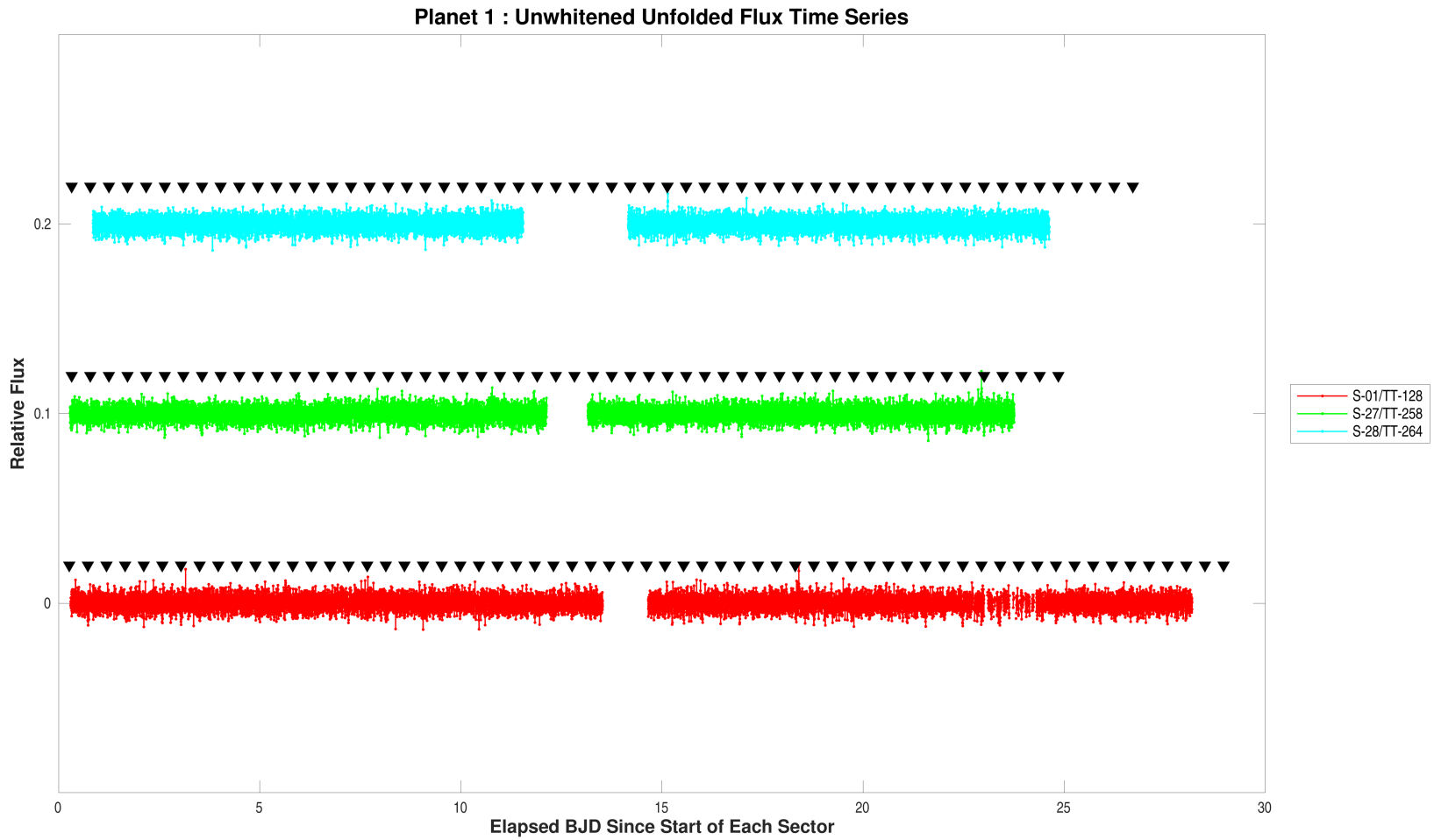
Model Characteristic	Name
Transit Model	mandel-agol_geometric_transit_model
Limb Darkening Model	claret_tess_nonlinear_limb_darkening_model

TCE Parameter	Value	Units
Trial Transit Pulse Duration	0.5	hours
Transit Epoch	1325.7245592	TJD
Orbital Period	0.4629275	days
Maximum SES	6.0	
Maximum MES	38.9	
Robust Statistic	47.1	
Chi Square Goodness of Fit Statistic (DoF)	2220.6 (2085)	
Chi Square2 Statistic (DoF)	250.7 (340.8)	
Threshold for Desired PFA		

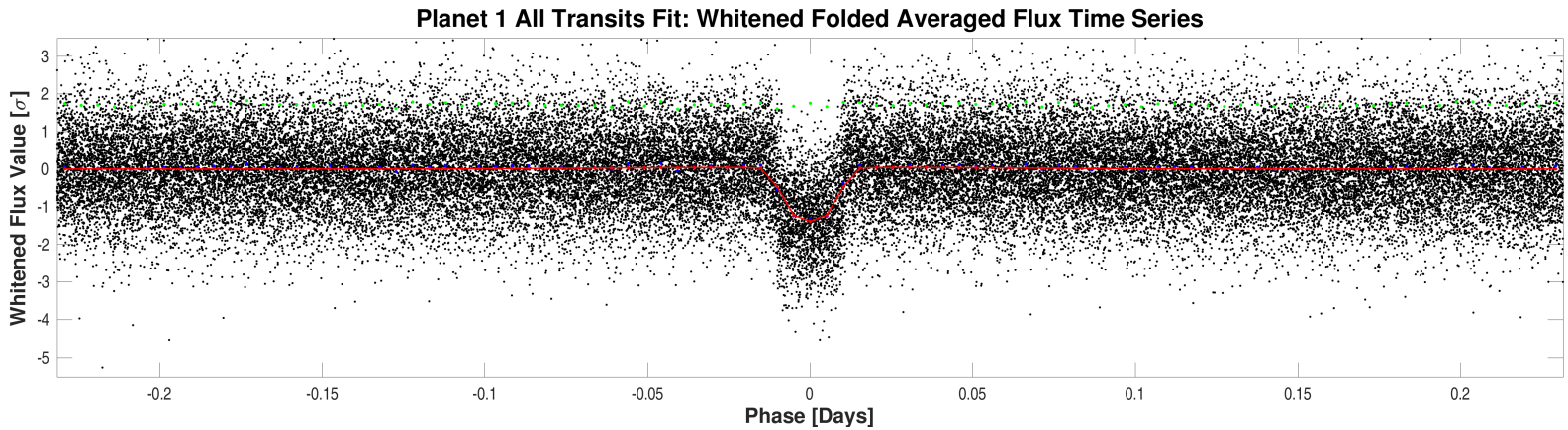
DoF: Degrees of Freedom

Parameter	Value	Uncertainty	Units
SNR	53.1		
Orbital Period	0.4629307	3.8723e-06	days
Transit Epoch	1325.7246835	1.5644e-04	BTJD
Impact Parameter	0.8993	1.6199e-02	
Planet Radius to Star Radius Ratio	0.0736788	2.0079e-03	
Semi-major Axis to Star Radius Ratio	3.4247	2.1894e-01	
Planet Radius	1.5172	6.1800e-02	Earth radii
Semi-major Axis	0.0063	1.9097e-04	AU
Effective Stellar Flux	64.7095	1.3896e+01	Goldilocks
Equilibrium Temperature	723	3.8836e+01	Kelvin
Stellar Density	2.5181	4.8293e-01	Solar density
Transit Depth	4678	1.7168e+02	ppm
Transit Duration	0.6310	2.2202e-02	hours
Transit Ingress Duration	0.1967	4.0336e-02	hours
Eccentricity	0.0000	0.0000e+00	
Peri Longitude	0.0000	0.0000e+00	degrees
Model Chi Square Statistic (DoF)	13319.9 (16089.9)		
Model Chi Square Goodness of Fit Statistic (DoF)	2019.7 (3384)		
Model Chi Square2 Statistic (DoF)	95.7 (151)		

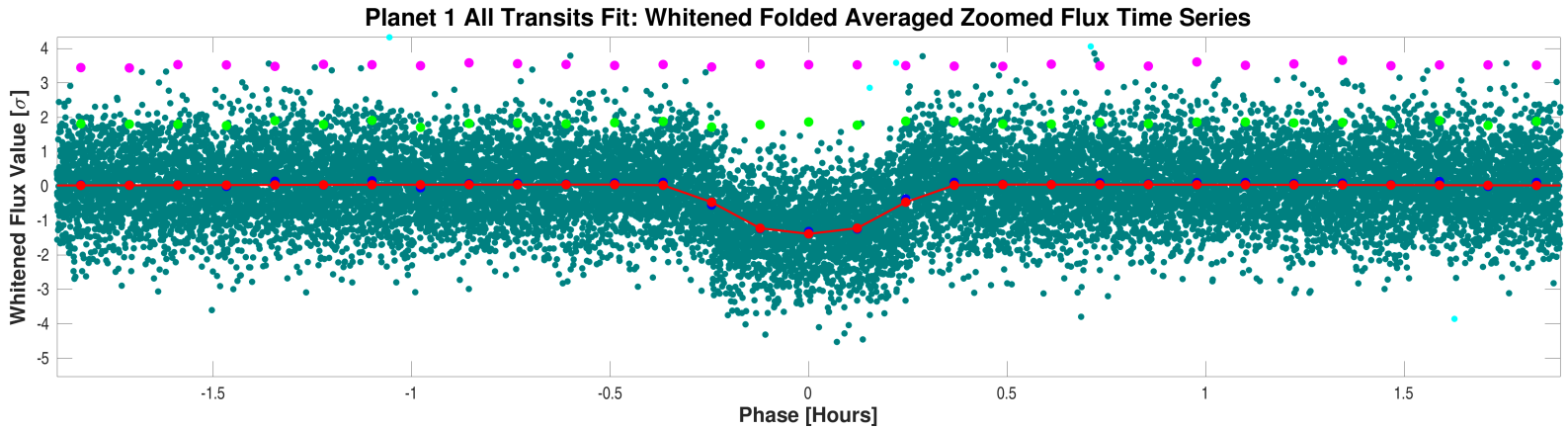
DoF: Degrees of Freedom



Flux time series for CatId 410153553, Planet candidate 1 in the unwhitened domain. For the data of Sector-01/TargetTableId-128, start BJD is 2458325 and the vertical offset is 0. For the data of Sector-27/TargetTableId-258, start BJD is 2459036 and the vertical offset is 0.1. For the data of Sector-28/TargetTableId-264, start BJD is 2459061 and the vertical offset is 0.2. Transit event markers indicate the location of transits of the given planet candidate. All transits fit completed with full convergence. Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000410153553-01-all-unwhitened-01-128.fig`



Folded flux time series for CatId 410153553, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light curve of the all transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. All transits fit completed with full convergence.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000410153553-01-all-whitened.fig`

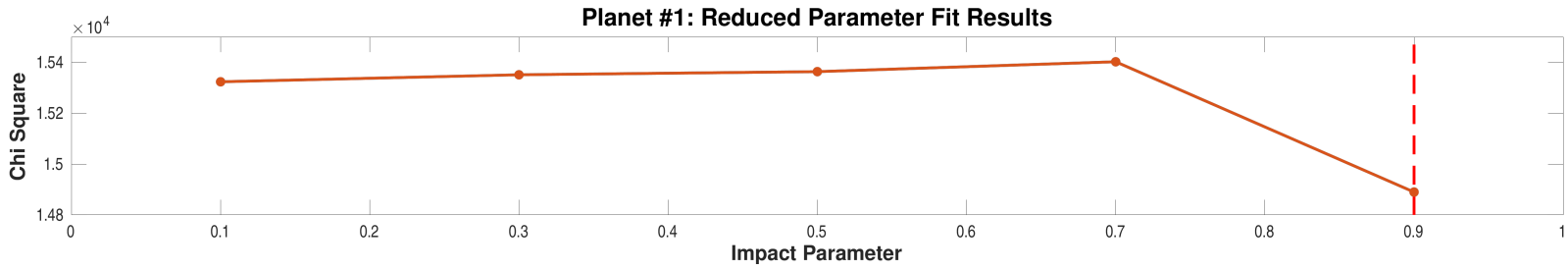


Folded flux time series for CatId 410153553, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the fitted model light curve of the all transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. Magenta dots are the averaged values of the folded flux time series, with a phase shift of 0.5 relative to the blue dots, vertically offset for clarity. All transits fit completed with full convergence.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000410153553-01-all-whitened-zoomed.fig`

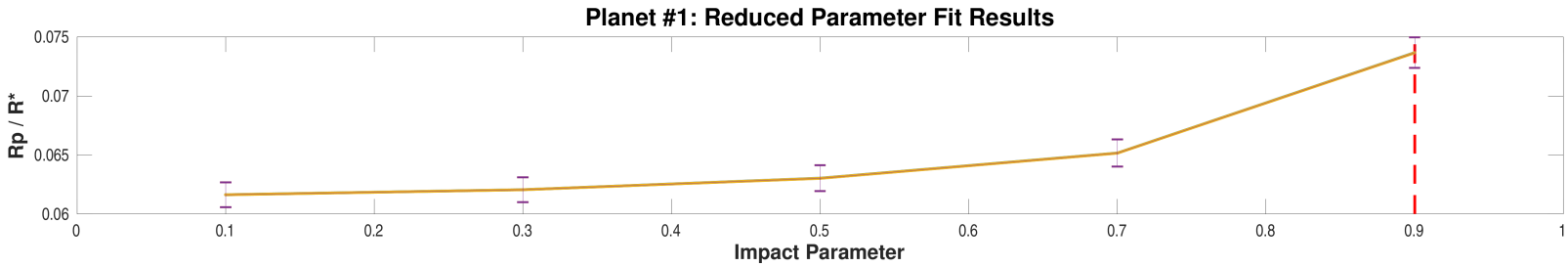
7.2 Model Fitter: Reduced Parameter Fit Results

Impact Parameter	SNR	Model Chi Square	Planet Radius to Star Radius	Uncert	Semi-major Axis to Star Radius	Uncert	Transit Depth (ppm)	Uncert	Transit Duration (hours)	Uncert
0.10	53.2	15323.8	0.0616383	1.0464e-03	7.3914	1.1646e-01	4443	1.4990e+02	0.5075	7.9372e-03
0.30	53.0	15351.4	0.0620630	1.0566e-03	7.1160	1.1284e-01	4437	1.5010e+02	0.5085	8.0086e-03
0.50	52.4	15363.7	0.0630349	1.0871e-03	6.5236	1.0544e-01	4420	1.5143e+02	0.5118	8.2303e-03
0.70	51.7	15402.6	0.0651664	1.1468e-03	5.5034	9.2304e-02	4404	1.5382e+02	0.5220	8.7475e-03
0.90	55.2	14889.8	0.0736644	1.2915e-03	3.4306	6.0835e-02	4670	1.6021e+02	0.6288	1.1474e-02

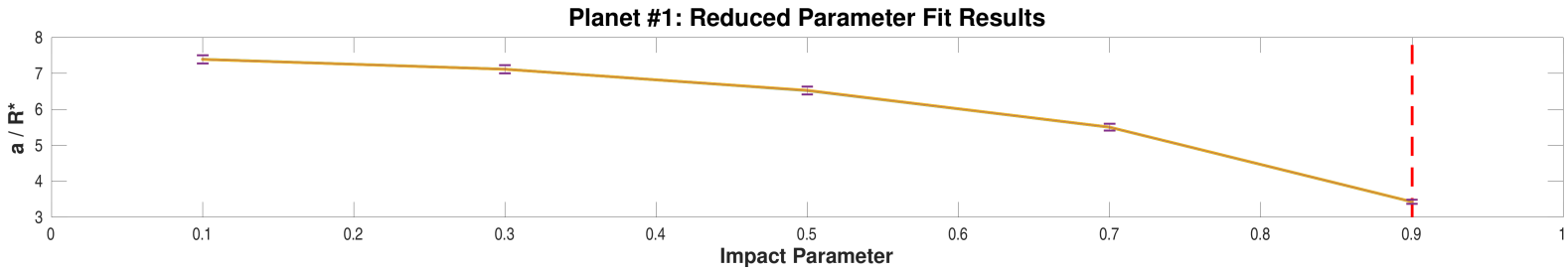
Highlighted row is the best reduced-parameter model fit.



Model chi squares of reduced parameter fits vs. impact parameter for CatId 410153553, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.
Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000410153553-01-reduced-fits-chi-square.fig`



Ratios of planet radius to star radius of reduced parameter fits vs. impact parameter for CatId 410153553, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.
Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000410153553-01-reduced-fits-rp-over-rstar.fig`



Ratios of semimajor axis to star radius of reduced parameter fits vs. impact parameter for CatId 410153553, Planet candidate 1. The fit result with the minimum chi square is marked with a dashed line in the plot.
Open `./planet-01/planet-search-and-model-fitting-results/reduced-parameter-fits/0000000410153553-01-reduced-fits-a-over-rstar.fig`

7.3 Model Fitter: Trapezoidal Fit Results

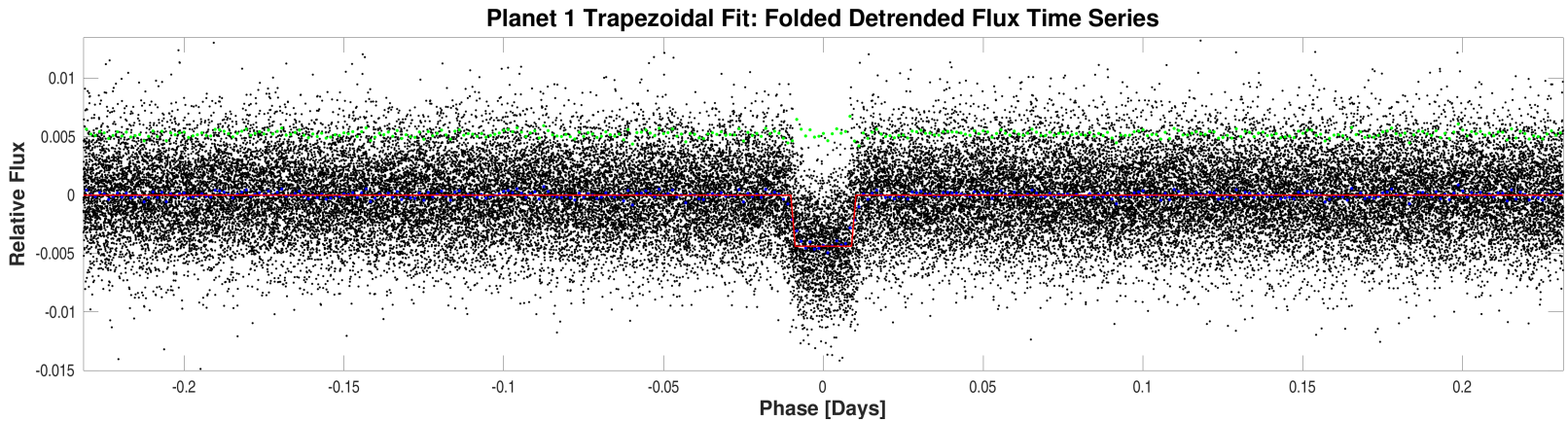
Model Characteristic	Name
Transit Model	trapezoidal_model
Limb Darkening Model	

TCE Parameter	Value	Units
Trial Transit Pulse Duration	0.5	hours
Transit Epoch	1325.7245592	TJD
Orbital Period	0.4629275	days
Maximum SES	6.0	
Maximum MES	38.9	
Robust Statistic	47.1	
Chi Square Goodness of Fit Statistic (DoF)	2220.6 (2085)	
Chi Square2 Statistic (DoF)	250.7 (340.8)	
Threshold for Desired PFA		

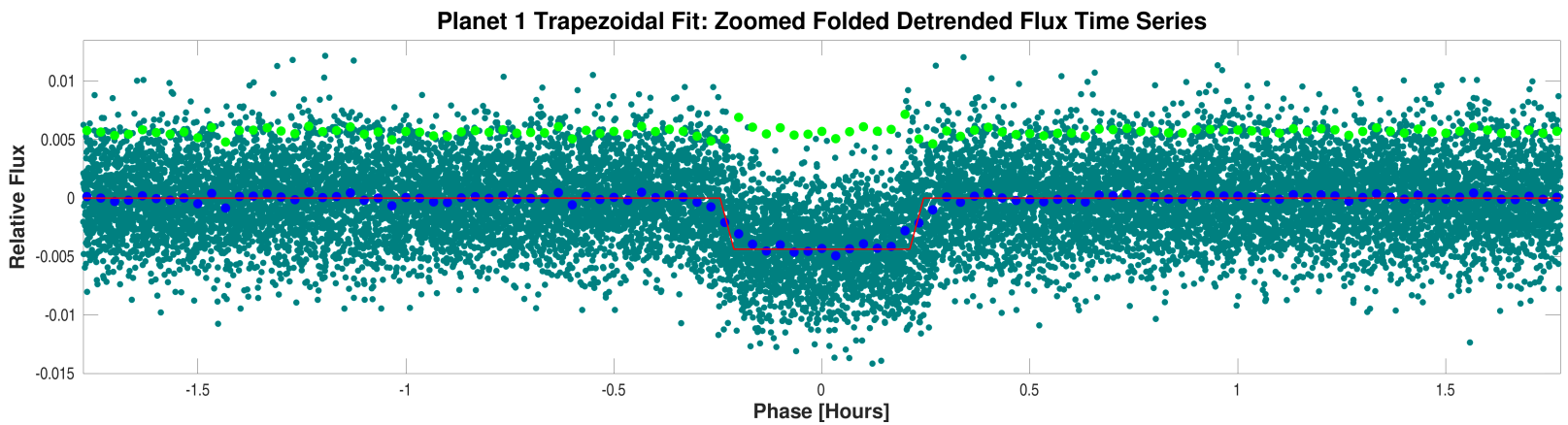
DoF: Degrees of Freedom

Parameter	Value	Uncertainty	Units
SNR	55.0		
Orbital Period	0.4629275		days
Transit Epoch	1325.7276788		BTJD
Transit Depth	4370		ppm
Transit Duration	0.5917		hours
Transit Ingress Duration	0.1358		hours
Model Chi Square Statistic (DoF)	50956.7 (17892)		

DoF: Degrees of Freedom



Folded detrended flux time series for CatId 410153553, Planet candidate 1 and folded trapezoidal model light curve.
Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000410153553-01-all-trapezoidal.fig`



Zoomed folded detrended flux time series for CatId 410153553, Planet candidate 1 and folded trapezoidal model light curve.
Open `./planet-01/planet-search-and-model-fitting-results/trapezoidal-model-fit/0000000410153553-01-all-trapezoidal-zoomed.fig`

7.4 Validation Tests

The Centroid Test and Eclipsing Binary Discrimination Test are chi-squared hypothesis tests. For these tests, a significance of 100% favors a planet, while 0% indicates an unlikely planet.

7.4.1 Weak Secondary Test

Result	Value	Uncertainty	Units	Statistic in Sigmas	Significance (%)
Orbital Period	0.46293		days		
Transit Duration	0.5		hours		
Maximum MES	38.9				
Secondary Phase	-0.072917		days		
Secondary MES	1.6				
Minimum Phase	0.28376		days		
Minimum MES	-3.0				
Median MES	-0.3				
MAD MES	0.66611				
Robust Statistic	1.3				
Secondary Depth	115.5	8.0934e+01	ppm		
Geometric Albedo	1.1	7.8020e-01		0.1382	44.51
Planet Effective Temperature	1147	2.1027e+02	Kelvin	1.9831	2.37

7.4.2 Eclipsing Binary Discrimination Test

Result	Value	Value in Sigmas	Significance (%)
Odd Even Transit Depth Comparison Statistic	6.1079e-03	0.0782	93.77

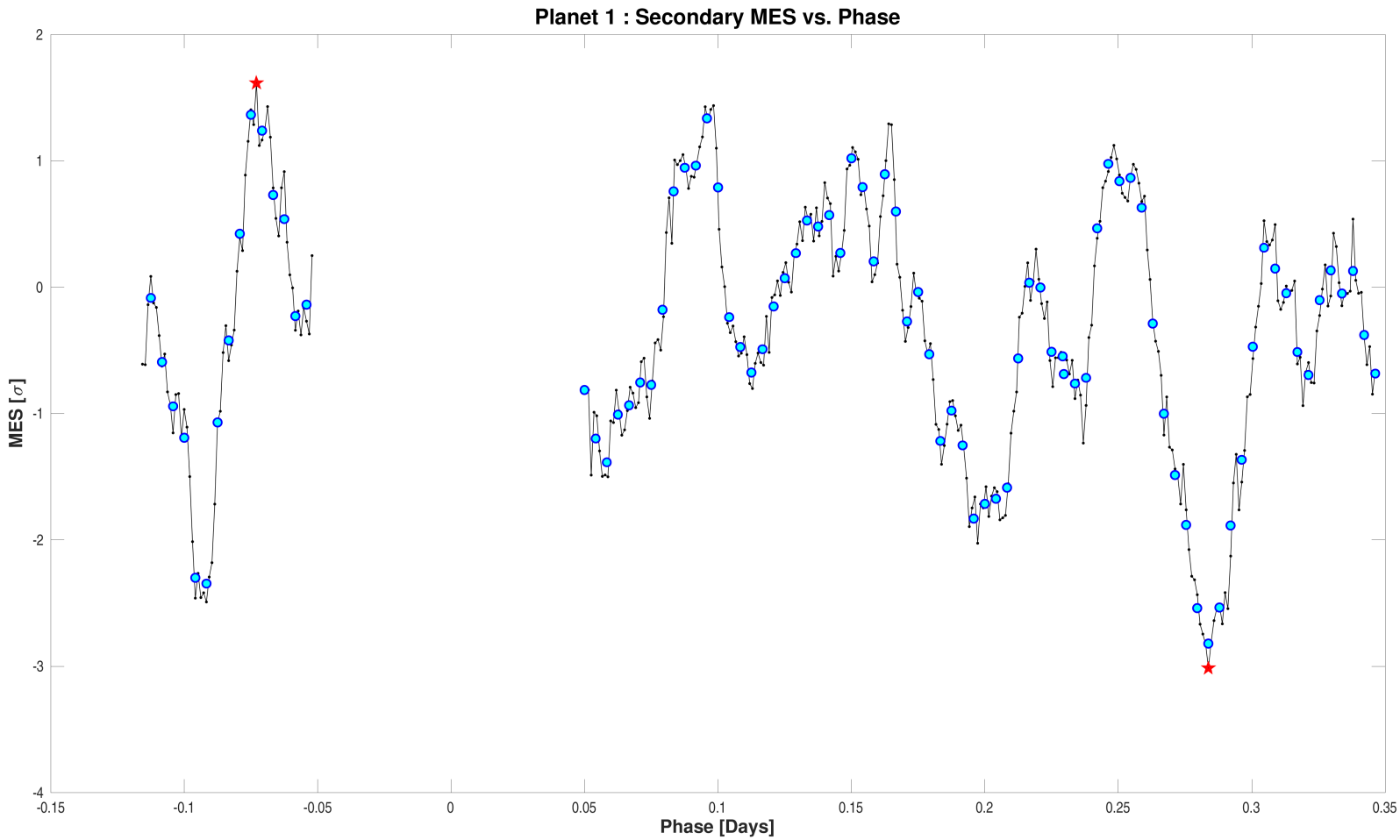
7.4.3 Bootstrap Test

Result	Value
False Alarm Probability	2.9090e-314
Bootstrap Threshold for Desired PFA	6.9
MES Mean	-0.44
MES Standard Deviation	1.04
Transit Count	1645

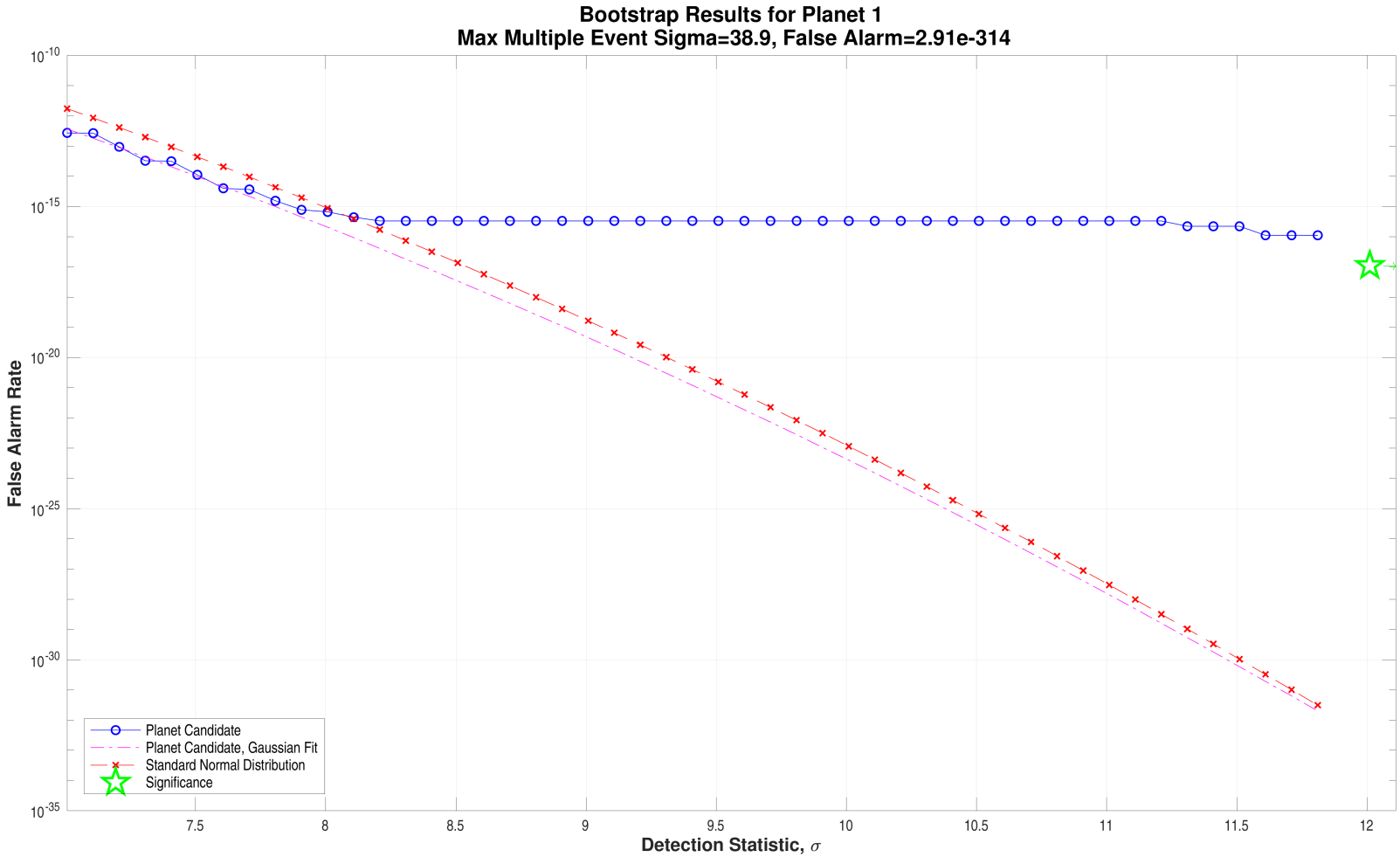
7.4.4 Ghost Diagnostic Test

Result	Value	Significance (%)
Maximum MES	38.9	
SNR	53.1	
Core Aperture Statistic	3.2964e+01	100.00
Halo Aperture Statistic	7.9524e+00	100.00
Ratio of Core/Halo Aperture Statistics	4.1452e+00	

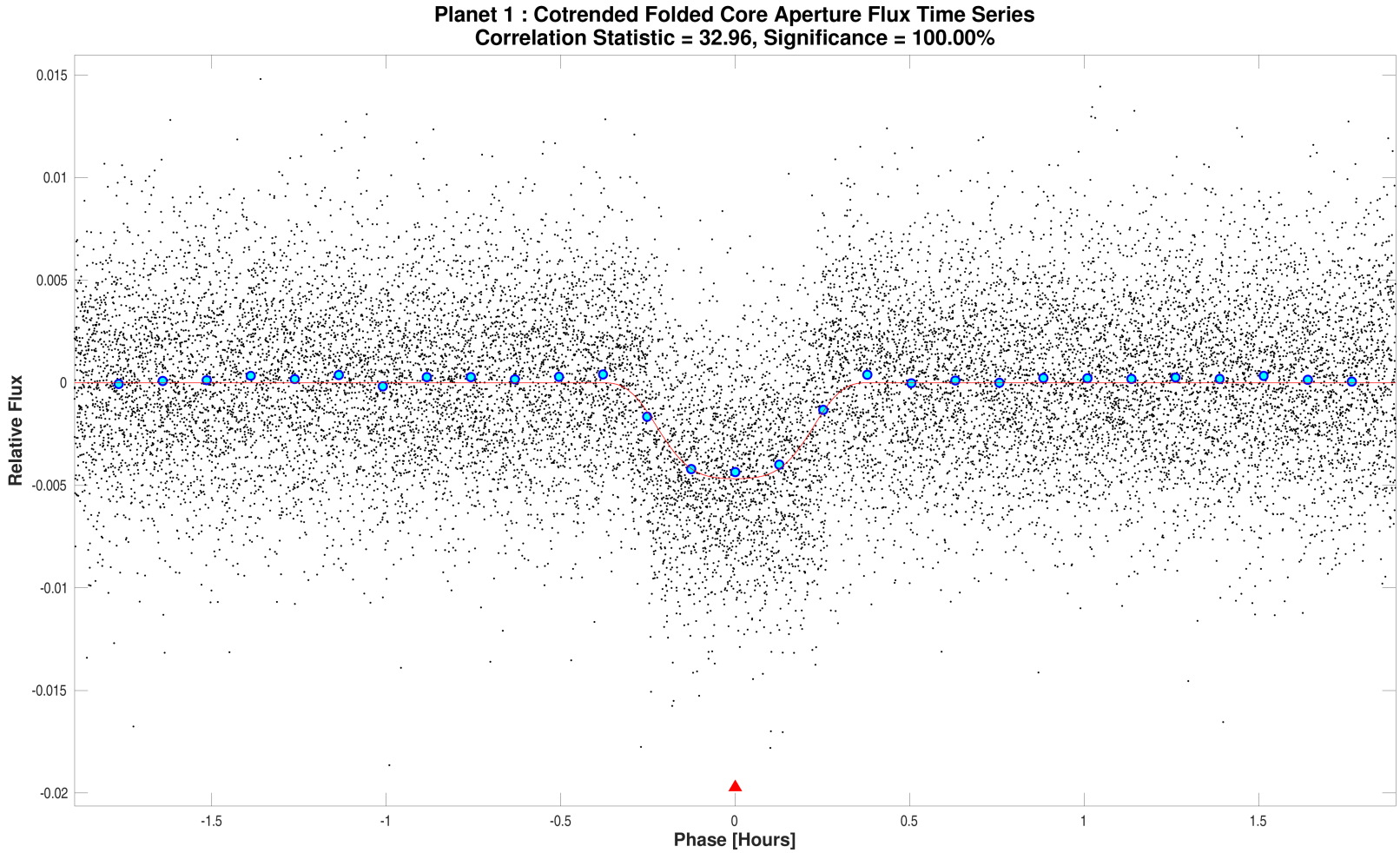
7.4.5 Validation Test Figures



The primary event has been set to zero and both the max and min of the resulting MES vs. Phase are marked with a red star. The best matched pulse duration in hours is 0.5. The maximum secondary MES and corresponding phase are 1.6175 and -0.072917 days respectively. The minimum secondary MES and corresponding phase are -3.0133 and 0.28376 days respectively.
Open `./planet-01/report-summary/0000000410153553-01-weak-secondary-diagnostic.fig`

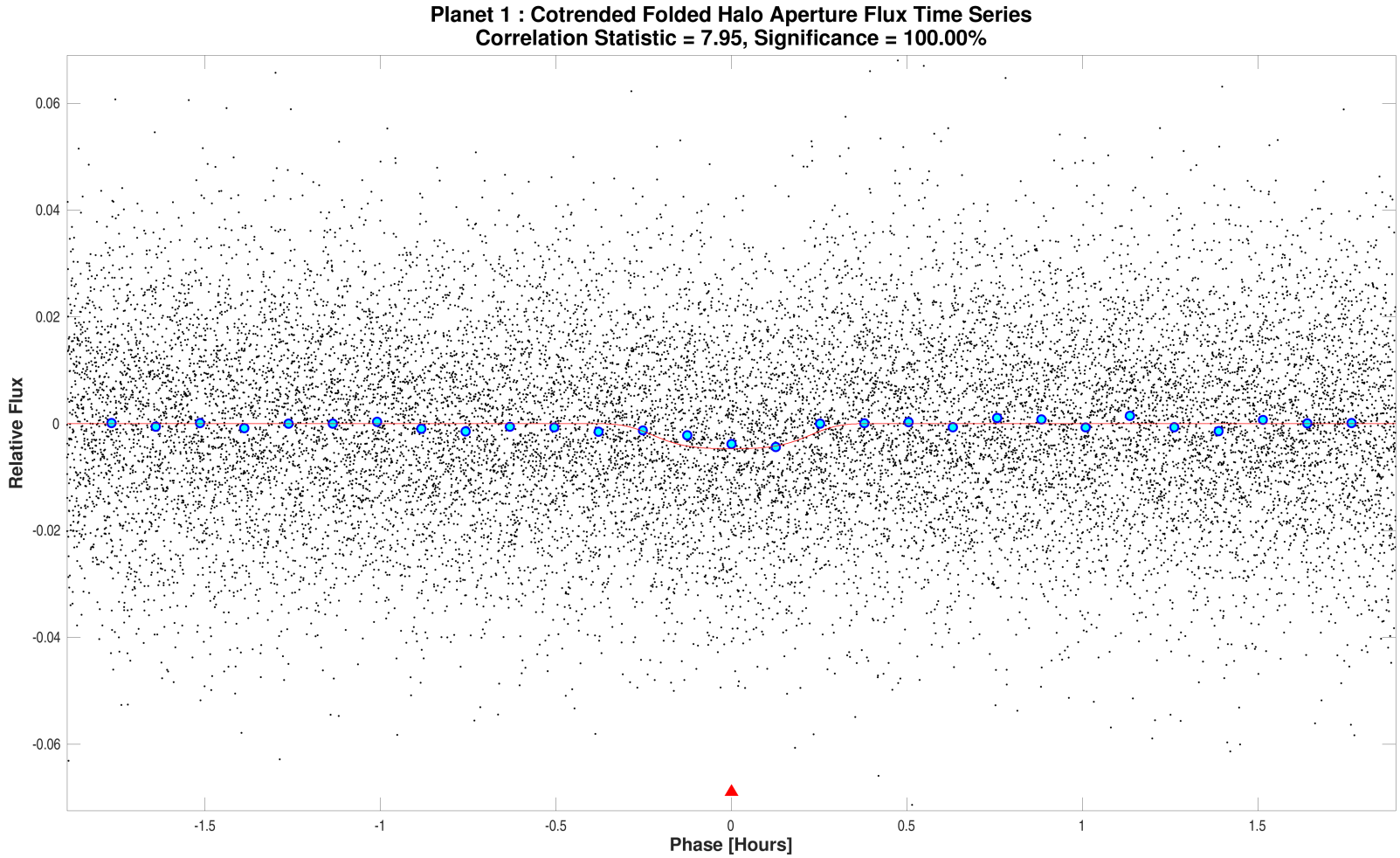


Bootstrap results for target 410153553, planet 1. Cumulative sum of the probabilities (derived from the histogram of counts) from upper tail to the search transit threshold; false alarm probability is indicated by the star. The Gaussian equivalent threshold for this false alarm probability is 37.8785. The threshold on this distribution that achieves the same false alarm rate as a 7.1 sigma threshold on a Gaussian distribution is 6.9346.
Open `./planet-01/bootstrap-results/0000000410153553-01-bootstrap-false-alarm.fig`



Optical ghost diagnostic core aperture flux time series for target 410153553, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft engineering data, motion proxies, and/or cotrending basis vectors (CBVs) to remove systematic effects. Flux time series data represent the mean per pixel flux in the core or haloaperture; phase folded data points are shown in the figure with black dots. Binned and averaged phase folded flux values are marked with filled blue circles. The unwhitened transit model light curve is displayed in the figure with a red line. The value and significance of the core aperture correlation statistic are displayed in the figure title if the statistic was successfully computed.

Open `./planet-01/ghost-diagnostic-results/0000000410153553-01-core-unwhitened-cotrended-zoomed-model.fig`

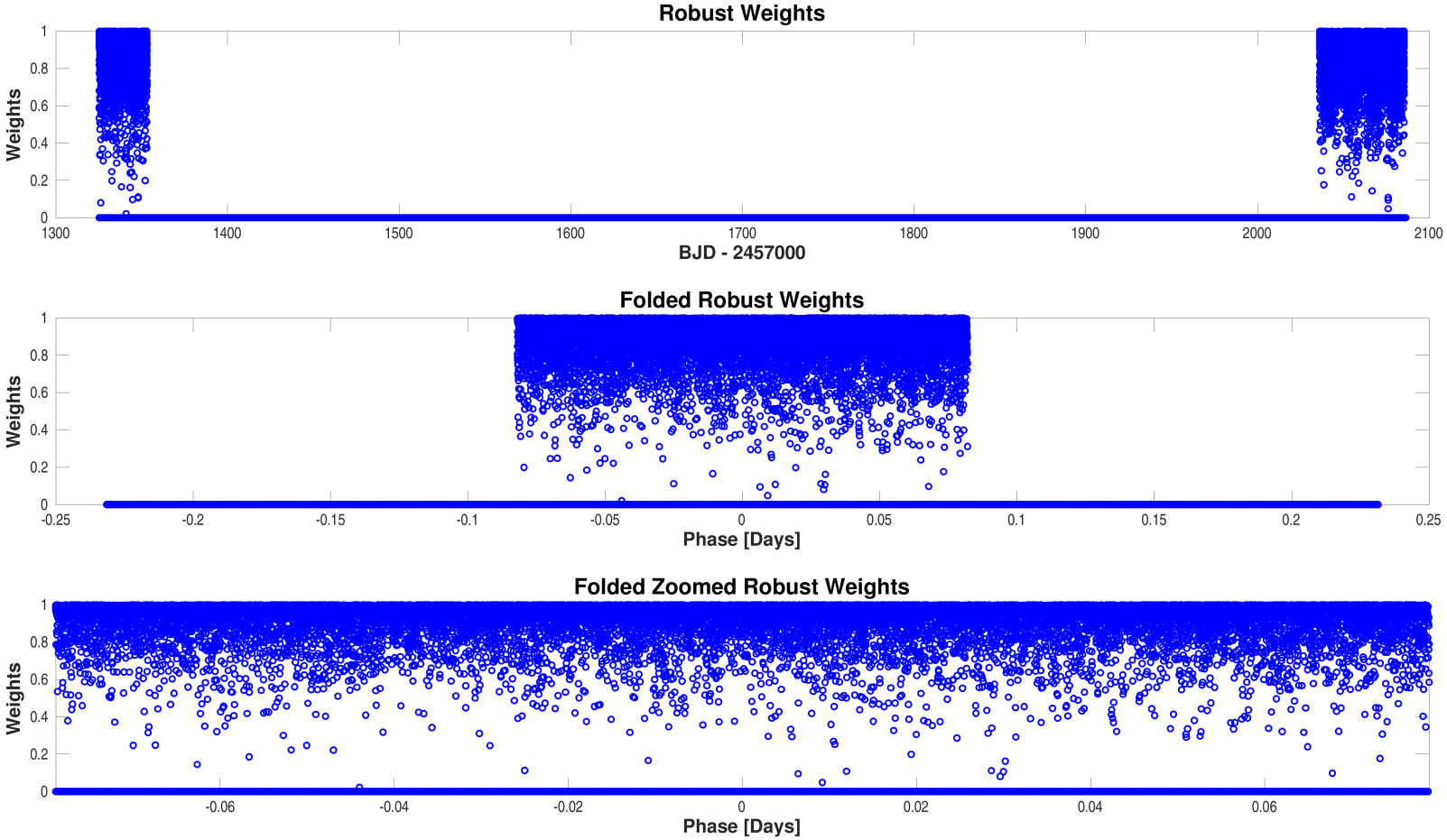


Optical ghost diagnostic halo aperture flux time series for target 410153553, planet candidate 1. The unwhitened time series is phase folded at the orbital period associated with the planet candidate and centered on the epoch of the first transit. The time series was first cotrended against spacecraft engineering data, motion proxies, and/or cotrending basis vectors (CBVs) to remove systematic effects. Flux time series data represent the mean per pixel flux in the core or haloaperture; phase folded data points are shown in the figure with black dots. Binned and averaged phase folded flux values are marked with filled blue circles. The unwhitened transit model light curve is displayed in the figure with a red line. The value and significance of the halo aperture correlation statistic are displayed in the figure title if the statistic was successfully computed.

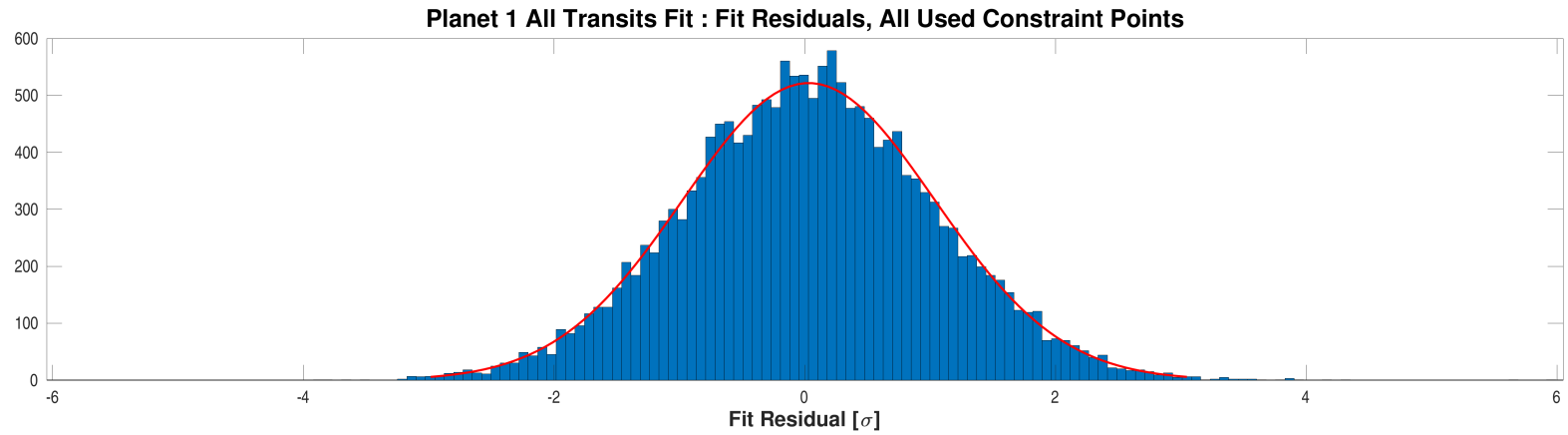
Open `./planet-01/ghost-diagnostic-results/0000000410153553-01-halo-unwhitened-cotrended-zoomed-model.fig`

Appendix A Planet Candidate 1

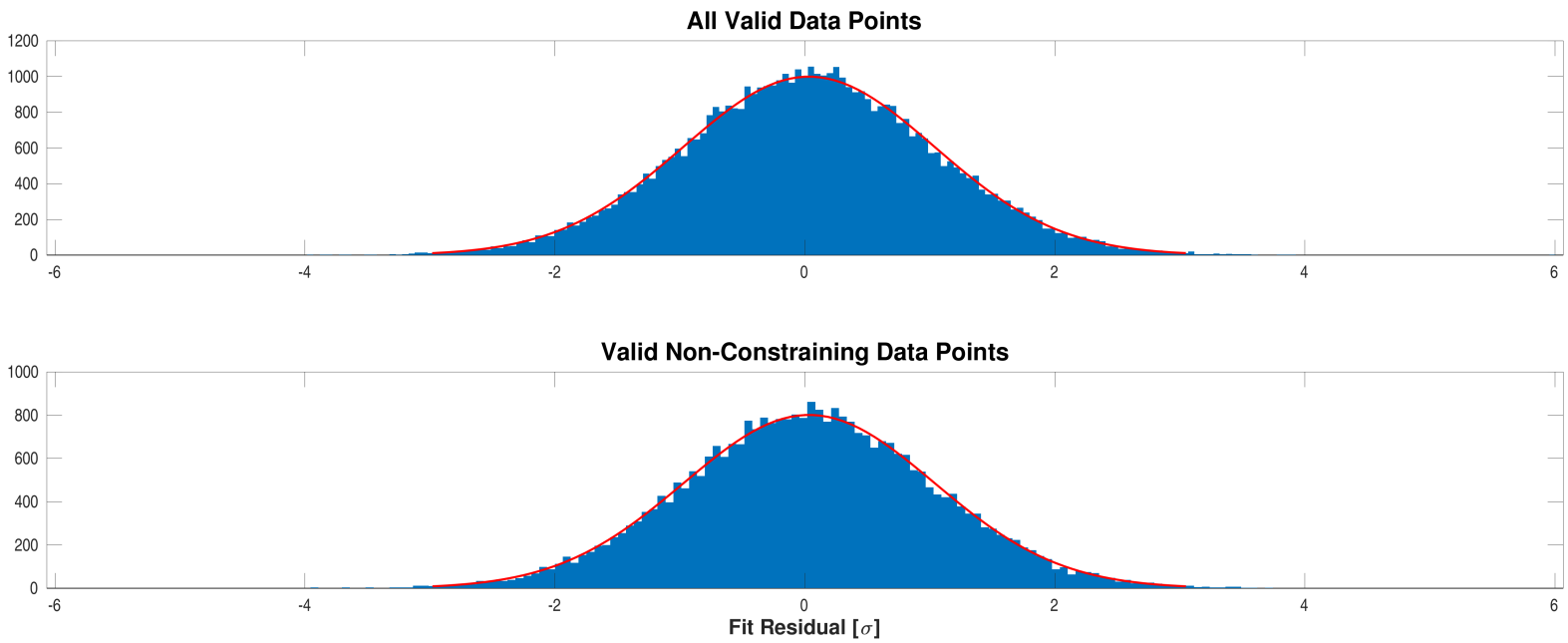
A.1 Model Fitter: All Transits



Robust weights distribution for CatId 410153553, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000410153553-01-all-robust-weights.fig`



Fit residuals distribution for CatId 410153553, Planet candidate 1. Only the valid data points used to constrain the fit are shown here. A Gaussian fit to the histogram is shown in red.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000410153553-01-all-histo-used.fig`

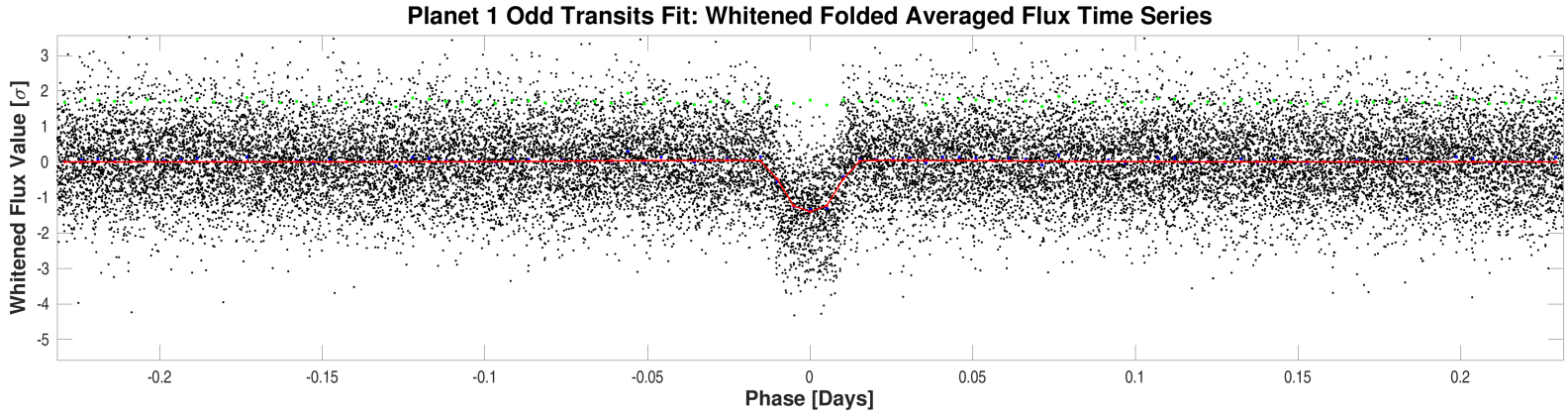


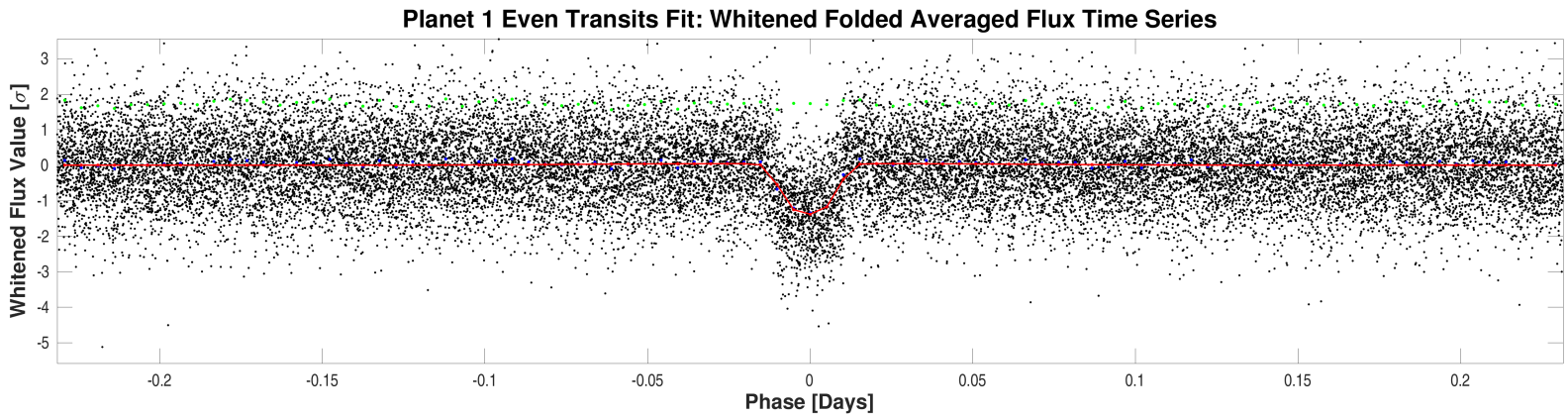
Fit residuals distribution for CatId 410153553, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.
Open `./planet-01/planet-search-and-model-fitting-results/all-transits-fit/0000000410153553-01-all-histo-all-and-unused.fig`

A.2 Model Fitter: Odd & Even Transits

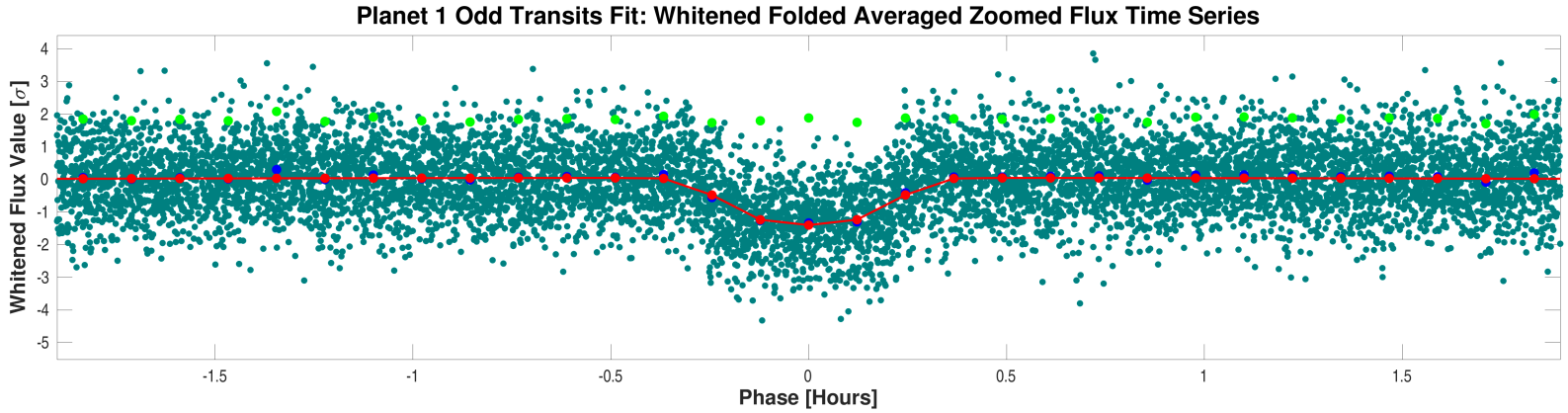
Parameter	Odd Transits Value	Odd Transits Uncertainty	Even Transits Value	Even Transits Uncertainty	Units	Difference $\frac{\lVert}{\lVert}$Uncertainty$\rVert$
SNR	38.0		37.3			
Orbital Period	0.4629309	5.4474e-06	0.4629305	5.3513e-06	days	4.7040e-02
Transit Epoch	1325.7247024	2.2221e-04	1326.1875402	2.1837e-04	BTJD	2.9826e-01
Impact Parameter	0.8987	2.3082e-02	0.8993	2.2870e-02		1.9279e-02
Planet Radius to Star Radius Ratio	0.0737640	2.8260e-03	0.0735982	2.8080e-03		4.1635e-02
Semi-major Axis to Star Radius Ratio	3.4211	3.1010e-01	3.4232	3.0857e-01		4.8904e-03
Planet Radius	1.5190	7.4168e-02	1.5155	7.3815e-02	Earth radii	3.2641e-02
Semi-major Axis	0.0063	1.9097e-04	0.0063	1.9097e-04	AU	1.2131e-05
Effective Stellar Flux	64.7094	1.3896e+01	64.7095	1.3896e+01	Goldilocks	3.4066e-06
Equilibrium Temperature	723	3.8836e+01	723	3.8836e+01	Kelvin	3.4066e-06
Stellar Density	2.5101	6.8256e-01	2.5149	6.8005e-01	Solar density	4.8945e-03
Transit Depth	4694	2.4157e+02	4668	2.3779e+02	ppm	7.8153e-02
Transit Duration	0.6330	3.1503e-02	0.6312	3.1228e-02	hours	3.9922e-02
Transit Ingress Duration	0.1963	5.6763e-02	0.1964	5.6774e-02	hours	2.1575e-03
Eccentricity	0.0000	0.0000e+00	0.0000	0.0000e+00		
Peri Longitude	0.0000	0.0000e+00	0.0000	0.0000e+00	degrees	
Model Chi Square Statistic (DoF)	13324.1 (16086.5)		13324.1 (16086.5)			

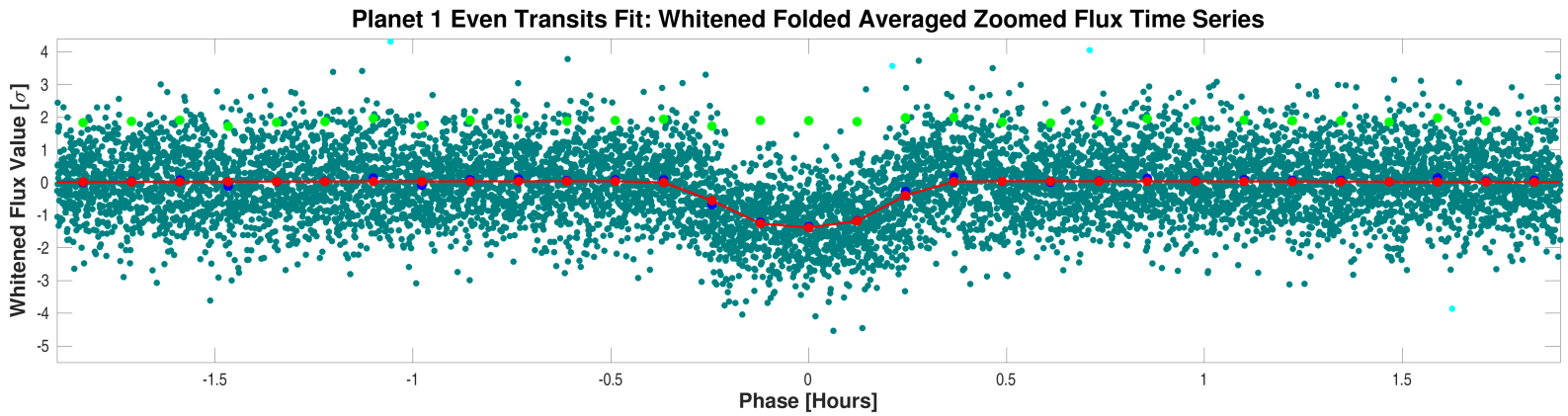
DoF: Degrees of Freedom



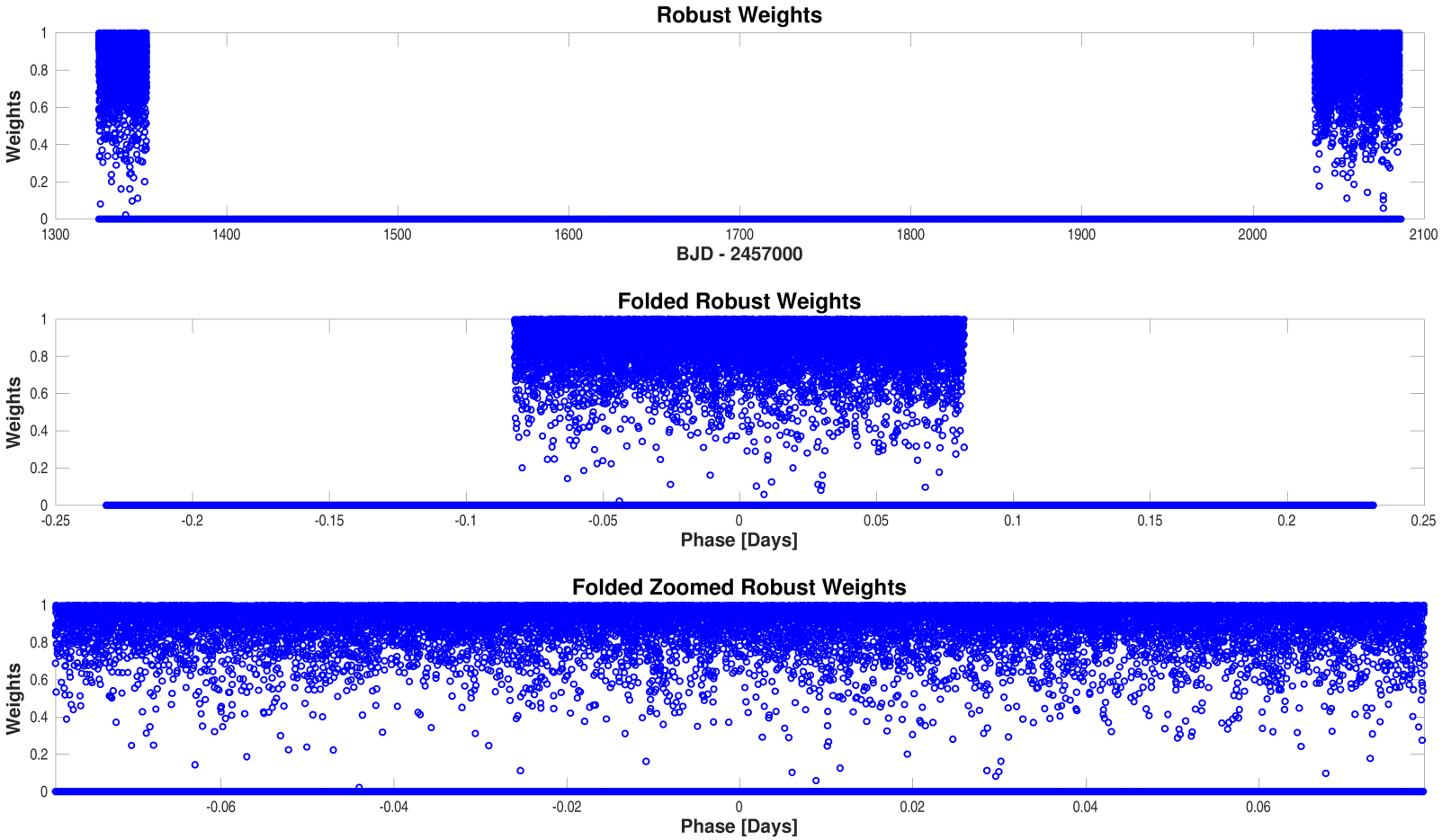


Folded flux time series for CatId 410153553, Planet candidate 1 in the whitened domain is plotted in black dots. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the folded model light curve of the odd/even transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. Odd-even transits fit completed with full convergence.
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000410153553-01-odd-even-whitened.fig`

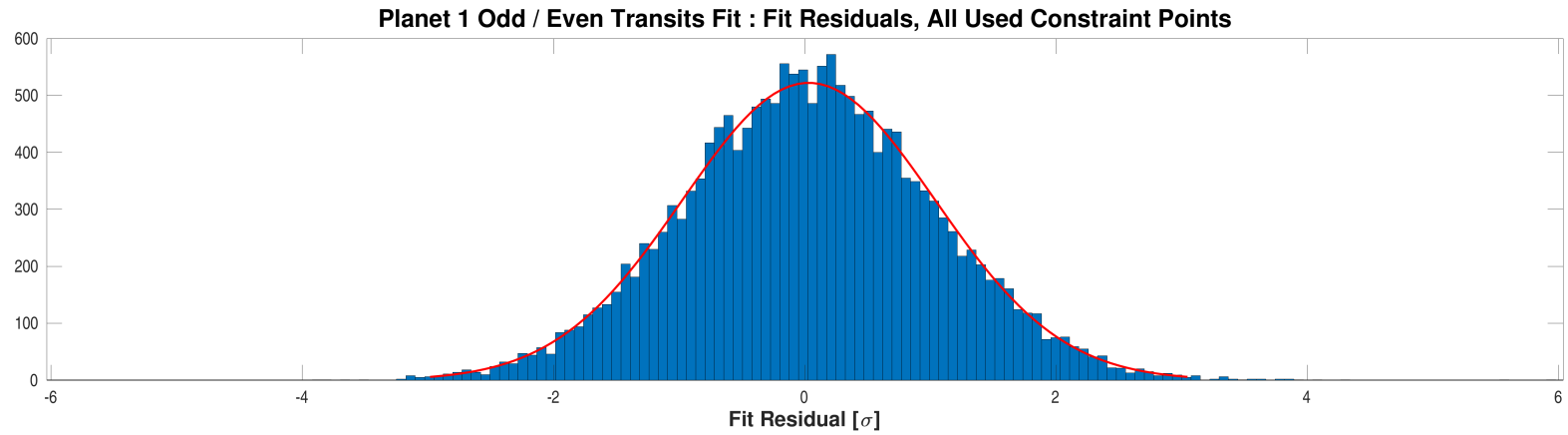




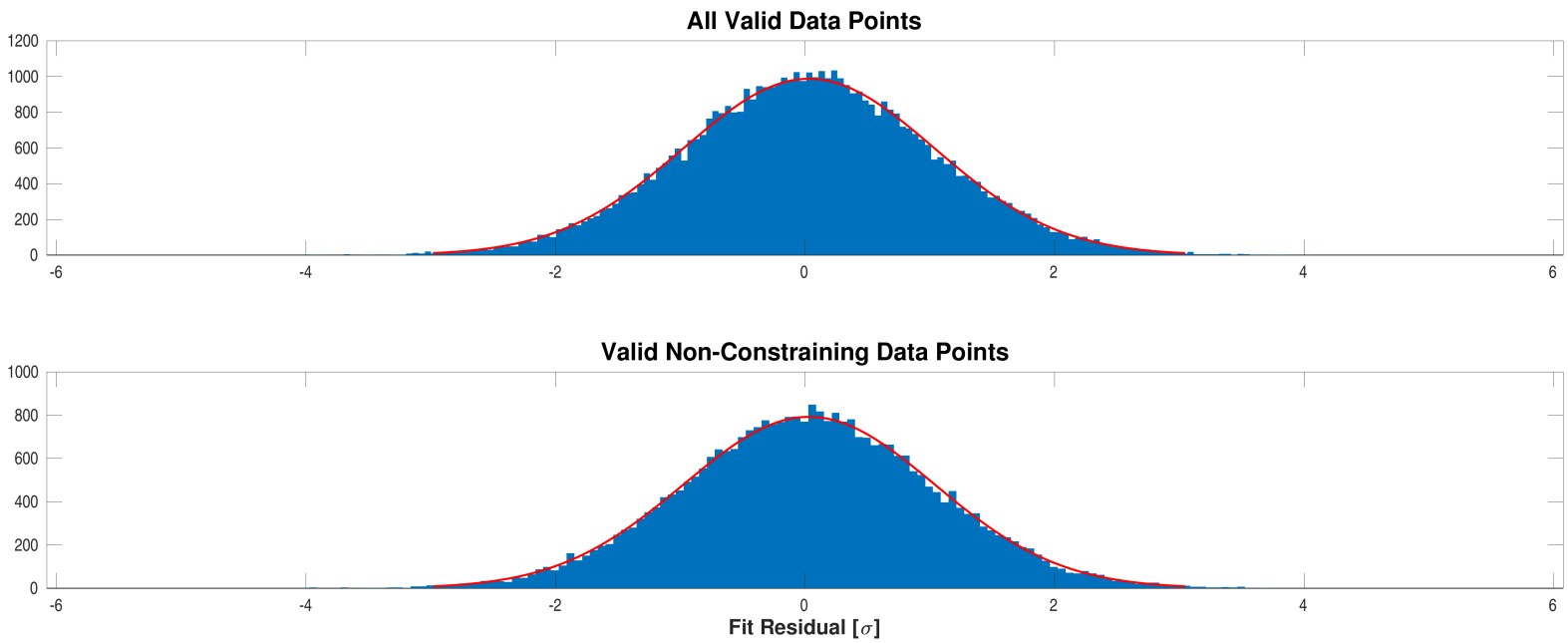
Folded flux time series for CatId 410153553, Planet candidate 1 in the whitened domain, zoomed on the transit. The flux data whose robust weights are larger/smaller than 0.1 are plotted in dark green/cyan dots, respectively. Values are averaged into 1 cadence wide bins. The blue dots represent the averaged values of the folded flux time series; the red dots represent the averaged values of the fitted model light curve of the odd/even transits fit; the green dots are the averaged folded fit residuals, vertically offset for clarity. Magenta dots are the averaged values of the folded flux time series, with a phase shift of 0.5 relative to the blue dots, vertically offset for clarity. Odd-even transits fit completed with full convergence.
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000410153553-01-odd-even-whitened-zoomed.fig`



Robust weights distribution for CatId 410153553, Planet candidate 1. Top plot: all data points. Middle plot: all data points, folded per the fitted period and epoch. Bottom plot: all data points, folded and zoomed.
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000410153553-01-odd-even-robust-weights.fig`

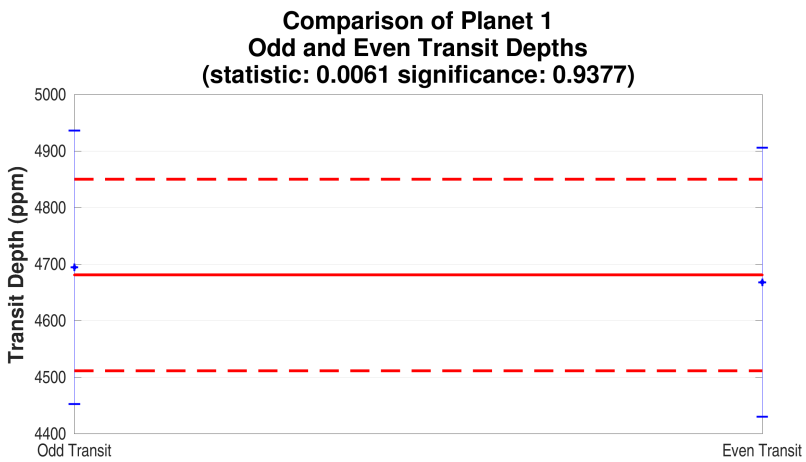


Fit residuals distribution for CatId 410153553, Planet candidate 1. Only the valid data points used to constrain the fit are shown here. A Gaussian fit to the histogram is shown in red.
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000410153553-01-odd-even-histo-used.fig`



Fit residuals distribution for CatId 410153553, Planet candidate 1. Top plot: all valid data. Bottom plot: valid data not used to constrain fit (due to distance from a transit). Gaussian fits to the histograms are shown in red.
Open `./planet-01/planet-search-and-model-fitting-results/odd-even-transits-fit/0000000410153553-01-odd-even-histo-all-and-unused.fig`

A.3 Eclipsing Binary Discrimination Test



Top-left: Diagnostic plot of Odd/Even Transit Depth Test for catId 410153553, planet 1. A significance level close to 1/0 favors a transiting planet/an eclipsing binary. Open `./planet-01/binary-discrimination-test-results/0000000410153553-01-eclipsing-binary-discrimination-tests.fig`

Appendix B Alerts

This target did not trigger any alerts.